Development of Second Order Understanding as a Basis for Organisational Improvement

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Abstract

Most if not all organisations claim to pursue a continued improvement philosophy. The processes often adopted are predominantly concerned with the collection and analysis of data. Such approaches take little account of the opinions or varying points of view of the affected groups or individuals. Within this research, these processes are referred to as first order processes. The thesis explores what is termed the second order of organisational improvement, placing the emphasis of the inquiry on the worldviews of those involved. The research includes a study of peoples' attitudes towards organisational improvement and an in depth review of the relevant literature.

Initial research consisting of questionnaires and interviews, gave an indication of the willingness within the workforce to engage in improvement activities. This led to the development of a model looking to understand and incorporate the differing worldviews of individuals, into action plans to improve the situations of concern, and an improvement process embedding understanding of others' perspectives and worldviews, dialogical communication and systems thinking. Incorporation of the differentiation of opinions and views of the people affected is central to the second order process.

Implementation is possible in any organisation that enjoys an open trusting environment, irrespective of the operational sector. The major contribution of the process is in the change of emphasis from establishment of a commonly held shared view of a situation, to understanding the differences between worldviews of those involved. In effect, the second order process explores the differences in opinions and beliefs that underlie how individuals view a situation. The aim is to understand peoples' different views and incorporate those views in any agreed action.

Acknowledgments

The Research was supervised by:

Petia Sice
Margaret Graham
Leonard Minkes

The research was undertaken in order to develop an alternative cooperative people based organisational improvement process within the researched organisation. Additionally an identified gap in the combined area of 'second order' and systems thinking based improvement process knowledge existed.

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Declaration

I declare that this is all my own work and has not been submitted for any other award. I also certify all requirements set out by Northumbria University in the "Requirements for Presentation of Masters of Philosophy or Doctor of Philosophy" document as supplied by the Graduate School Office have been complied with.

An appendix containing published papers contains the names of any joint authors along with the conference or journal publishing the paper.

J. R. Brown

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1 CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION AND RESEARCH QUESTION

The idea for the subject of the research originated as part of the experience gained whilst working at the researched company as a production engineer. The organisation that has been the focus of this research is located in Northumberland and so referred to as 'Northumberland Manufacturing'. The company is one of a number of companies forming a multinational group. The researched site manufactures rescue and escape compressed air breathing equipment. The products sustain a clean air supply in non-breathable atmospheres, often in life threatening situations to fire fighters and other search and rescue personnel. Accordingly, reliability in use must be beyond question. The organisation' and customers' prime concern is the quality of the product. While the traditional customer concerns of cost, delivery and reliability remain, growing customer sophistication brings into consideration factors such as, environmental and social issues. Such factors have now become organisational considerations in today's overall total quality conscious markets. As a result, organisations that fail to take overall quality seriously are doomed to failure. Accordingly, organisations that claim to be interested in the continued improvement of quality and performance need to understand the meaning of 'quality'. Even so, quality definitions vary: 'conformance to requirements' (Crosby, 1979), 'value' & 'conformance to specification' (Reeves, 1994), 'fit for purpose' (Juran, 1995), 'loss avoidance' (Taguchi, 1989) and 'meeting or exceeding customer expectations' (Spencer, 1995). However, Total Quality Management (TQM) combines quality and organisational improvement into an overriding framework encompassing all aspects of quality and performance. Northumberland Manufacturing use TQM to define its organisational improvement policy. The framework adapted named the "Business Excellence SysTems, is commonly referred to as 'BEST.' Based on the European Foundation of Quality Management (EFQM) model, BEST has only one recognised organisational improvement process, named the Problem Solving Process (PSP) shown in Figure 1.

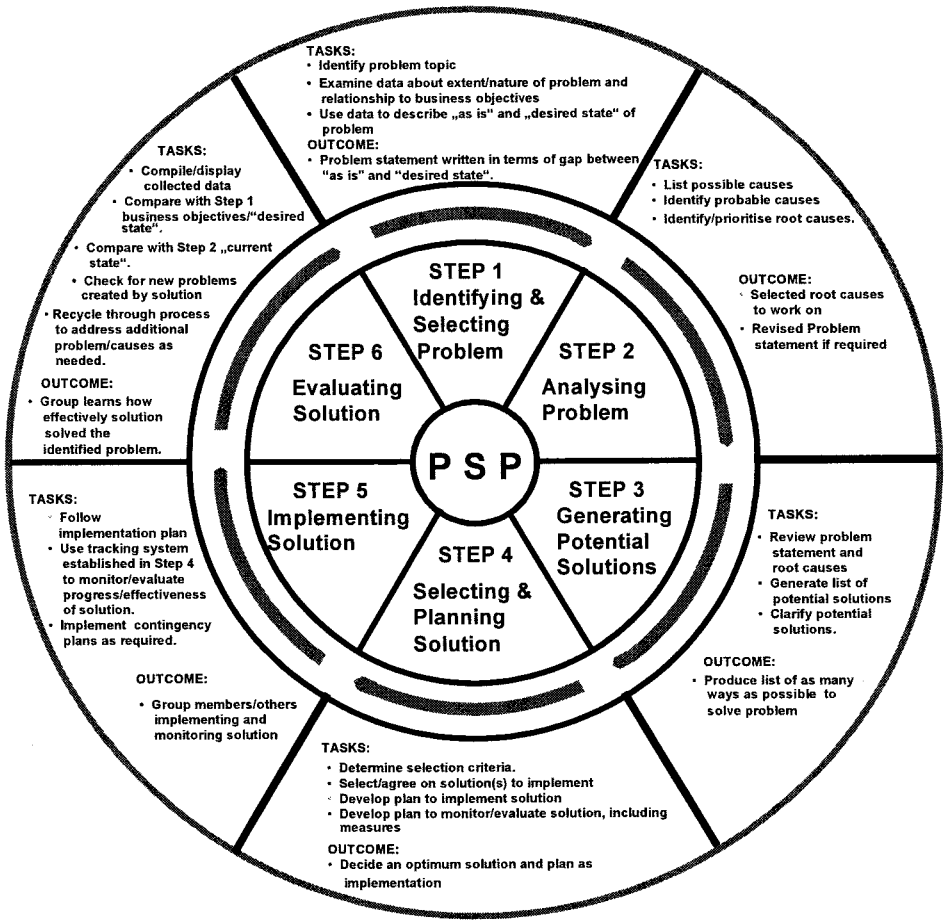

Figure 1, The Problem Solving Process (PSP)
Model sourced from company's quality manual

The PSP is a closely ordered systematic procedure. The six steps are carried out in sequential order, with outputs from one becoming inputs to the next. This is an objective inquiry, examining only objective facts. The synergy of multiple worldviews and the opportunity of co-evolving reality through engaging in understanding others' understandings of reality are not considered. This reductionism, subject/object dualistic approach, is typical of the manufacturing sector. For example, one of the first steps of the PSP is to define the root cause of the problem. No contemplation of the possibility that the problem may have many levels or contributing factors acting in unison is considered. Common problems with the root cause philosophy are its linear nature, difficulty in accommodating feedback and not allowing iteration. Added to these faults the name PSP, leads to the assumption the process is used only when rectifying problems.

The PSP has drawbacks that an approach taking account of the synergy of multiple worldviews and understanding others' understandings, would overcome. The process to be developed is for use by the members of an organisation as a means of continuous improvement to their organisation. If the members of the organisation request academic facilitation or specialist input, it is possible to accommodate such members into the composition of the improvement team. Nevertheless, the success of an improvement process depends on the level of organisational commitment to TQM. Dale (2003) points out there are a number of levels of TQM and therefore organisational improvement adoption ranging from Level 1, 'Uncommitted', to Level 6, 'World Class'. Northumberland Manufacturing with the adoption of TQM especially with regard to organisational improvement was at Level 3, 'Tool Pushers', when the research commenced. At this level, organisations have typically between three and five years experience with organisational improvement.

Northumberland Manufacturing in typical level 3 'tool pushing', has expended considerable effort and finances in delivering training to individuals who do not have the opportunity of implementing it in any practical way. The improvement tools, as applied by the operations department were used reactively and only on the instruction of the operations manager. Consequently, little organisational improvement has resulted.

Level 3 organisations implement externally purchased improvement tools in almost a militaristic way (Dale, 2003). Providing training, establishing problem solving groups, then project by project instruct them to apply the tools was the approach. Such organisations buy tools, training packages and programs, only to discard them when the novelty wears off. Continuously seeking the latest quick fix and then blaming the tools as ineffective when they fail to deliver expectations. In reality, organisations carrying out incorrect implementations cause the failures (Dale, 2003). This was the case with

Northumberland Manufacturing, with many tools purchased and implemented on the instructions of the operations manager. However, all failed to provide lasting improvement and fell into disuse. A need for a new approach to organisational improvement was evident.

1.2 UNDERPINNING REASONING OF THE NEED FOR A SECOND ORDER IMPROVEMENT PROCESS

Northumberland Manufacturing had over the years preceding the development of the Second Order Improvement Process (SOIP), attempted to implement several improvement processes. These included quality circles, in which employees were encouraged to generate suggestions. When quality circles failed, the Deming Wheel or Plan Do Check Act (PDCA) cycle was introduced. Considerable employee training took place utilising an external consultancy (Forward Vision). The consultants conducted training with groups of employees that included PDCA theory and practical exercises. Use of theoretical improvement situations, resulted in the employees envisaging the training as an academic exercise. Following attempts to coerce employees to take part in PDCA improvements by the operations manager. It became clear that individuals were attending improvement meetings but not taking part. The PDCA cycle failed to produce meaningful results, subsequently becoming disused by the workforce.

Following the failure of the PDCA cycle, Kaizen training covering theory and practice was delivered to the majority of the operations department, each operations employee subsequently being instructed to join a Kaizen team. Like previous imposed processes, Kaizen failed. Finally, the Problem Solving Process (PSP) became the official organisational improvement process when the company adopted the BEST total quality management framework. The failure of these processes was predictable from the comments of Easton and Jarrell (1998), who maintain that such imposed processes are

difficult to sustain. While Keating et al (1999) maintain that in their opinion it is not possible to purchase fully functional improvement process.

Northumberland Manufacturing eventually adopted the PSP as their only allowed improvement process. However, the PSP has flaws that make it unsuitable for some situations. Additionally, the process utilises a set of standardised documents effectively suppressing adaptability and creativity. For example, the main document, entitled the 'story board', compels improvement teams via the language and terminology to use gap analysis. The failure of imposed improvement processes, alongside the shortcomings of the PSP is an indication of the failure of understanding; individuals cannot be compelled to take part in improvement activities. People can be compelled to attend meetings but attendance and participation are not the same. These factors initiated the development of an alternative approach to organisational improvement. A 'second order' process brings people together, to improve issues important to themselves as well as management. A process based on developing understanding of the issues, in terms of those involved and not as with the PSP, in the terms of some preordained set of actions to undertake and procedures to follow and documents' to complete.

Having examined the process used within the organisation and concluding that existing organisational improvement processes and procedure were ineffective, the decision to find an alternative became the starting point for subsequent inquiries. The inquiries began with an examination of EFQM. This framework is people based, encompassing in its nine sections the employees of an organisation, its customers', suppliers', the people in the locality of the company and others affected by the activities of the organisation. In exploring the possible approaches, cooperation between individuals fitted with the EFQM model and the general comments of the workforce. Thus, the question became, what type of system was required and how could it be developed. In order to begin, the main features

of the proposed process required identification. As a starting point, this researcher decided to utilise the insights gained from organisational improvement training already delivered.

Two of the processes the management had delivered considerable training to implement, were the PDCA and Kaizen processes. Both are tried and tested reliable organisational improvement processes. Examination of these processes, gave a first insight into the formation of the underpinning philosophical standpoint of the new process.
The PDCA or Deming Wheel used throughout industry since the nineteen fifties shown as Figure 2 below, is the basis of most organisational improvement approaches.

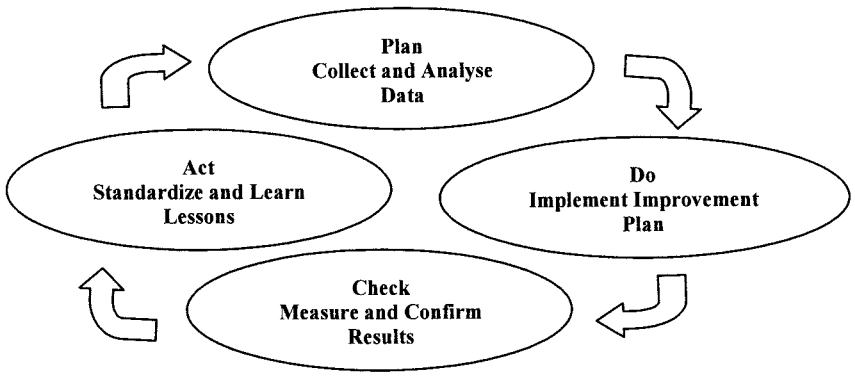

Figure 2, The Deming Wheel PDCA Cycle
Reproduced from Slack et al (1998)

The PDCA cycle comprises four elements: Plan, Do, Check and Act, each having specific roles. The 'Plan' stage establishes the objectives and processes necessary to deliver results in accordance with the specification of the improvement activity. 'Do' has the role of implementing the processes. While 'Check' monitors, processes results against objectives and specifications, reporting the outcome. Finally, 'Act' applies modifications implemented actions if required. This means reviewing all steps (Plan, Do, Check, Act) and modifying the implemented actions if required.

The process is iterative, building on the knowledge gained from previous cycle (Deming, 1996). While The PDCA forms the basis for many improvement processes, it remains a data centric approach. The four stages of the PDCA cycle do not allow for the development of understanding of others' perspectives.

The Kaizen process continues to be in use with great success in many organisations. Kaizen in Japanese means 'change for the better'. The English translation is 'continuous improvement', or 'continual improvement'. However, it can be traced back to the Chinese Buddhist tradition where it is termed 'gai shan'. 'Gai' meaning change for the better or improve and 'shan' meaning 'good or benefit. Benefit in this instance, is related to the Buddhist philosophy, which gives the definition as the action that 'benefits' the society but not one particular individual (i.e. multilateral improvement). In other words, one person or group cannot benefit at another's expense. The benefit involved here is sustainable, in other words the 'shan' is an act that benefits others. A newly developed process should include the above philosophical underpinning, operating in a spirit of cooperative inquiry to achieve continuous improvement. The Northumberland Manufacturing Kaizen manual had as the main themes of the process the following concepts. Kaizen aims to inspire effective team working by increasing employee involvement; promotion of personal and leadership development; increased quality and customer consciousness amongst those taking part. The overall goal is to develop self-directed employees and generate a climate of continuous improvement. While the above are all issues, an organisational improvement process should be striving to achieve, understanding of others' points of view and opinions allied with a sharing of ideas. These factors were not a priority within the organisation and contributed to the failure of both the PDCA and Kaizen methods

The Kaizen philosophical approach towards improvement with sustainable benefit for all, combined with the added dimension of 'understanding of others understanding' formed the

central philosophical standpoint of the process to be developed. The PSP as a typical first order process taking account of data without consideration of understanding has the drawbacks previously described. On the other hand the new, second order process takes account of the synergy of multiple worldviews and the understanding others' understandings to co-evolving reality.

1.3 RESEARCH QUESTION AND CONTRIBUTION TO KNOWLEDGE

In developing, a new process, a perspective differing from the traditional is required. In contrast to simply defining the data and effects of a situation as absolute truths, we need to see the variation of opinions held by those observing the situation. This is the differentiation between first and second order processes. Maturana (1970) makes the comment "*We are all observers as anything said even to ourselves is said by an observer*". While von-Foerster(1979) maintains "*that and anything said is said to an observer*". Therefore, whenever we hold a conversation or exchange our view of the world, we act as an observer speaking to another observer. For this reason, improvement team members are observers of the situation of interest. Each member will have a personal perspective and viewpoint of the factors influencing the observed situation. The improvement process to be developed will concentrate on exploration of these perspectives and the differing understandings of individuals. This is the second order understanding of the situation. The research will focus on the role second order understanding plays in organisational improvement. Thus, the research question becomes:

"How can 'second order' practices be used in enhancing the process of continuous organisational improvement"?

1.4 RESEARCH OBJECTIVES

The envisaged research objectives are:

1. Identify the limitations of the currently widely used first order organisational improvement process
2. Define second order understanding and the characteristics of a second order approach
3. Explore the potential of utilising second order understanding' and the advantages it brings to the process
4. Develop the second order process in the context of the 'BEST/EFQM' framework, based on understanding the people within that process

The essence of the research is the combination of theory and practice in action research that, marries them into a process of second order organisational improvement. Initially formed from pure theory; then adapted and strengthened from practical application over several iterations, thus providing new insights into a second order improvement process. This practical improvement process is workable, as well as providing a contribution to knowledge. A second contribution will be the reflections on the application of the process through case studies into its use. The studies will provide examples of the marriage of theory and practice in working situations.

1.5 LAYOUT OF THE THESIS

Chapter 1

The chapter covers; the shortfalls in the organisational improvement process used within the researched organisation. Investigation for need for a second order process is undertaken and the research question stated.

Chapter 2

The second chapter covers the methods and methodology used. Asking the questions of Why? What? and Where? to research, the philosophical underpinning to the research is examined.

Chapter 3

This chapter covers the primary research and analysis. This phase of the research develops an understanding of the social background of the researched organisation. The identification of the subject areas pertinent to the research concludes the chapter.

Chapter 4

This chapter is a review of the literature covering the bodies' of knowledge identified as pertinent to the research and development of the organisational improvement process. These include second order Philosophy, Cognition, 'Relationship, Language and Communication along with Systems Thinking.

Chapter 5

This is a detailed explanation and review of each of the stages of the 'second order' organisational improvement process. Stage aims, objectives and relationship to other stages in the process are covered.

Chapter 6

The sixth chapter contains two case studies of the process in operation. The case studies chosen show the generic abilities' of the process. The first case looks into the introduction of a 'Time and Attendance' System' within Northumberland Manufacturing. The second case concerned a problem encountered with the 'Lung Demand Valves' produced by the organisation.

Chapter 7

This chapter examines the development of the Second Order Improvement Process SOIP. The importance of the involvement of volunteers who have an interest in the issues under examination are explored.

Chapter 8

This chapter reviews the SOIP and compares it to other improvement process such as the PDCA cycle and Kaizen

Chapter 9

This chapter reviews the research, reiterating the main points and issues arising. The chapter concludes with an inquiry of the possible future adaptations and developments.

2 CHAPTER 2: METHODOLOGY AND METHODS

The aim of the overall research is the development of a cooperative people based approach to organisational improvement. Such an approach will be termed a second order understanding approach, based on the assumption that we must understand others motivations in order to come to shared agreements. For such an approach, people must be willing participants in team improvement activities (Checkland, 1981). Senge (1990) use the term 'shared vision' to describe this willingness to participate, meaning a vision held by all members of the team of how they want things to be. Commitment to a shared vision described, as an attitude that whatever is required within the spirit of the law to achieve the vision will take place. Such vision is a panacea for cooperative team improvement through second order understanding not often encountered. Consequently, a committed shared vision is an extremely rare occurrence; the more likely situation is one of several possible degrees of compliance. Senge (1990) lists several levels beginning with 'genuine compliance' where an individual may not be committed in a shared vision sense, but sees the merits of the vision and is willing to do what is required and more, as long as it is within the letter of the law. Followed by 'formal compliance' where an individual sees the benefits and is willing to do what is expected but no more. Both levels of compliance are acceptable to a cooperative shared understanding approach. Lower forms of compliance include grudging, non-compliance and apathy are unacceptable, all of which are not conducive mutually agreed team action (Senge, 1990), tending not to bring about the results required.

However, genuine and formal compliance, all require an encompassing environment of mutual trust and respect for others. Empirical evidence suggests that such an environment of trust and respect existed to some degree within Northumberland Manufacturing.

The purpose of this chapter is to develop a methodology and set of methods that will best fit the social research, and allow the achievement of the overall aims. The term Methodology defined in the Encarta English Dictionary as '*the methods or organising principles underlying a particular art, science, or other area of study.*' is the definition used. Methodologies fall into two main categories; qualitative dealing with people their ideas' thoughts and beliefs' while quantitative deals with measurable data. This research utilises a qualitative approach, a diverse term that covers a multitude of methods. Seeking to translate and come to terms with the meaning, rather than the measurement of phenomena frequency within a social context. In other words, qualitative research tends to work with textual concepts rather than numbers (Schwandt, 2001).

2.1 METHODOLOGICAL QUESTIONS

When conducting any research, the researcher should be mindful of the issues surrounding his or her research. The starting point in any research should be the aim of increasing the accumulated pool of knowledge. In the case of this research, the knowledge of second order organisational improvement processes. Remenyi et al (2000) argues that three philosophical questions need addressing at the outset of any project. The three questions are; 'Why research?', 'What to research?', and 'How to research?' They also argue that the main group of the three previous questions extend to the additional question of 'Where to research?', while of lesser philosophical importance still requires attention.

2.1.1 Questions: Why, What, How and Where to Research

The question of why research has answers at two levels. The first level concerns the addition of knowledge to issues where understanding is incomplete. At this level, there is a general lack of understanding of second order and the need for organisational improvement to deliver results (Easton & Jarrell, 1998). Incomplete in two ways, firstly, organisational improvement as used in most organisations does not deliver the expected results. Secondly, existing methods tend to be problem solving orientated as is the PSP in

use at Northumberland Manufacturing. Such approaches are not creators of explorative innovation.

In business situations, failure to deliver expected results is a common occurrence due to the rapid rate of change within the market environment. Customer requirements change, environmental issues become important, the treatment of employees, ethical purchasing and pricing policies and many more issues have become the concern of organisational research. Additionally globalisation, wider communication networks and increased information processing requirements are becoming more prevalent; all require new methods of interpretation within organisational improvement. Pascal (1990) supports the statement that business and management studies lack a formulated body of knowledge in these areas. The second level of what to research relates to the need for improvement. There is a perpetual requirement for improvements in effectiveness and efficiency within organisations. Those that do not improve stagnate. They fall behind their competitors and eventually become unviable organisations. There is an incessant search for increased profit, better health care, products, travel and services at a lower price and higher quality. Society has come to a decision that knowledge is power (Remenyi et al, 2000) and therefore there is a continuing need to increase organisational knowledge of processes and procedures through continued research. This then is the second of the two answers that formed the main driving force behind the research into second order organisational improvement. Like other manufacturing organisations, Northumberland Manufacturing management claims to be concerned in improvement through the empowerment of people. Even so, this claim requires examination within the overall research as what an organisation claims to practice and what it actually practices often differ.

The question of what to research is inseparable from where to research. If the subject of the research is the more important of the two questions then 'where' is decided by the

availability of the situations in which the subject can be studied. Conversely, the opportunities offered within the research location can determine what to research. In the case of the second order process, the results of the primary research gave direction and focus to the main body of the research. In the form of development of an organisational improvement system, founded around cooperation between individuals and second order understanding, utilising systems thinking. Where to conduct the research linked naturally to the fact that this researcher was an employee of Northumberland Manufacturing. As an industrial engineer responsible for organisational improvement activities on a daily basis, 'what?', 'why?', and 'where?' to research questions became combined in the research leading to the development of the second order improvement process. This fortunate amalgamation of circumstances proved the ideal conditions for continued research of the cooperative process.

How to research the methods used and the philosophy underlying the research is the theme of the remainder of this chapter. A major concern for any researcher is the validity of his or her research. His or her peers, and the organisation or group supporting the researcher, must see the work as having merit and contributing to the body of knowledge into which the research falls. To do this an understanding of the processes of knowledge creation is required. However, the process of carrying out research is rather subjective and is dependent upon the intuition and inspiration of the researcher. Gould (1980) comments *"Science is not an objective truth directed machine, but a quintessentially human activity, affected by passion, hopes and cultural biases. Cultural traditions of thought strongly influence scientific theories.* How to research requires clarification of the underlying philosophical assumptions.

2.2 PHILOSOPHICAL ASSUMPTIONS

All research is based on a set of philosophical beliefs that shape and direct the methods used within an overriding methodology. The research into the second order improvement process contained several underlying theoretical areas detailed below.

2.2.1 Empirical Research

Empirical research is based on and guided by the results of observation or experiment. On the other hand, theoretical research is the study of the subject through the writings of others' and discourses with individuals seen as authorities in the field. While the research into the second order improvement process began with theoretical research to define, the first version of the process, empirical research took over from that point forward. However, it is sometimes difficult to collect evidence that leads to a convincing argument (Millar, 1994) and care is required in ensuring evidence collected is verifiable. Additional empirical exploration assumes an understanding of the subject under review. To put the philosophical argument into perspective, the researcher goes out into the world and observes phenomenon or carries out experiments. He or she studies these observations and collects related evidence, eventually drawing conclusions and adding to knowledge. The development of the second order organisational process utilised action research an approach that was empirical in nature.

Empirical research is the most commonly used in business and especially organisational improvement. Some see empirical research as being a positivist view, sometimes described as a tough-minded approach based on data. This is incorrect as empiricism can also be a phenomenological approach (Kuhn, 1962).

2.2.2 Research in the Social World

Social science, the body of knowledge concerning the study of people, is a phenomenon of the twentieth century, used for only about one hundred years. Business research is even

younger with the experiments of Hawthorne in the nineteen twenties and thirties being the first structured business research studies (Parsons, 1992). However, more than simple experiments like those of Hawthorn, who simply altered the level of lighting in a production environment and monitored the staff performance, is required to be able to claim an increase in the body of knowledge. More sophisticated methods such as second order thinking, dialogue and the mutual exchange of ideas is required to develop the understanding of the complex issues contained in organisational improvement (Remenyi, 1990).

Some scientists especially from the positivist natural sciences school of thought maintain that social science is not science at all. Claiming that, as social science does not result in general laws that are capable of falsification, means the method is non scientific. However, regarded this view as misinformed Habermas (1990) comments, "*Now we think more tolerantly about what might count as science*". In fact, social scientists claim that social science can deliver generic results that do possess generality. This is the case with the second order improvement process. While the process was developed and trials conducted at Northumberland Manufacturing, the model is applicable to other organisations in differing sectors such as education or health care. The second order model by its very nature has generality developed into the overall process.

The central philosophy of the research methodology is social constructionism. This is a belief that 'meaning is not discovered but constructed'. According to Crotty (1998) meaning is not inherent in objects but is waiting for someone to come up with it. Constructionists claim that people construct meaning as they interact with the world. From this viewpoint therefore, meaning or truth is not just objective neither is it completely subjective. We do not create meaning, we construct meaning, objectivity and subjectivity require holding together, and constructionism achieves this objective (Crotty, 1998).

The cultural background of those taking part in social research is a major contributing factor. Fish (1990) contends the individual make reality; however, he adds that the means by which an individual constructs reality is social. Individuals are embedded within institutions, and it is from the cultural base of these institutions that reality is perceived. Without culture we could not function, we depend on culture to direct our behaviour and organise our experiences. (Geertz ,1973). In the words of Geertz:

> *"Thinking consists not of happenings in the head (thought happens there and elsewhere are necessary for it to occur) but of a traffic in what have been called by Mead and others significant symbols – words for the most part, but also gestures, drawings musical sounds, mechanical devices like clocks or natural objects like jewels – anything in fact that is used to impose meaning upon experience". (Geertz, 1973)*

Individuals from birth are taught cultural values and beliefs from those around them. People become part of pre-existing systems and seek to attain pre-existing values. When we first see the world in meaningful ways, we can only view that world in terms of our culture. Thus, social construction is all embracing, we need to be aware that the reality we as observers perceive, is a reality created through the lenses of our culture. All reality is socially constructed; there is no exception (Harre, 1986). Not everyone agrees that social constructionism is the construction of social reality. In this interpretation, human beings create society; this point has been made by Greenwood (1994) in the following way:

> *Physical and social phenomena differ in one essential respect. Chairs may exist independently of our knowing that they do; our knowledge of the existence of chairs is not constructive of their existence. In contrast, social phenomena do not exist independently of our knowledge of them.*

However, as Heidegger (1971) and Merleau-Ponty (1962) both state, "*The world is always already there*". To them the chair exists as a chair only if conscious beings construe it as a chair. As a chair, it too is constructed sustained and reproduced through social life (Crotty, 1998). Giddens (1976) gives this view in the following quote:

> *The difference between the social and natural world is that the latter does not constitute itself as 'meaningful'; the meanings it had are produced by men in the course of their practical life, and as a consequence of their endeavours to understand and explain it for them selves. Social life of which these endeavours are a part on the other hand is produced by its component actors precisely in terms of their active construction and reconstruction of frames of meaning whereby they organise their experience.*

Whichever alternative is taken, that social realities are socially constructed is accepted by both schools of thought.

Therefore, the research undertaken to develop the second order improvement process took place in a social context. A social context that would influence, shape and determine the extent of the interactions possible. Nevertheless, while the cultural influence of the organisation is unavoidable in the development of the second order process the culture of Northumberland Manufacturing at the time of process development allowed a generic process to be developed.

The Research Process

The research undertaken followed a logical progression from the initial exploration of important themes, through to the evaluation of the second order process in practical organisational improvement situations. The main blocks are shown in Figure 3

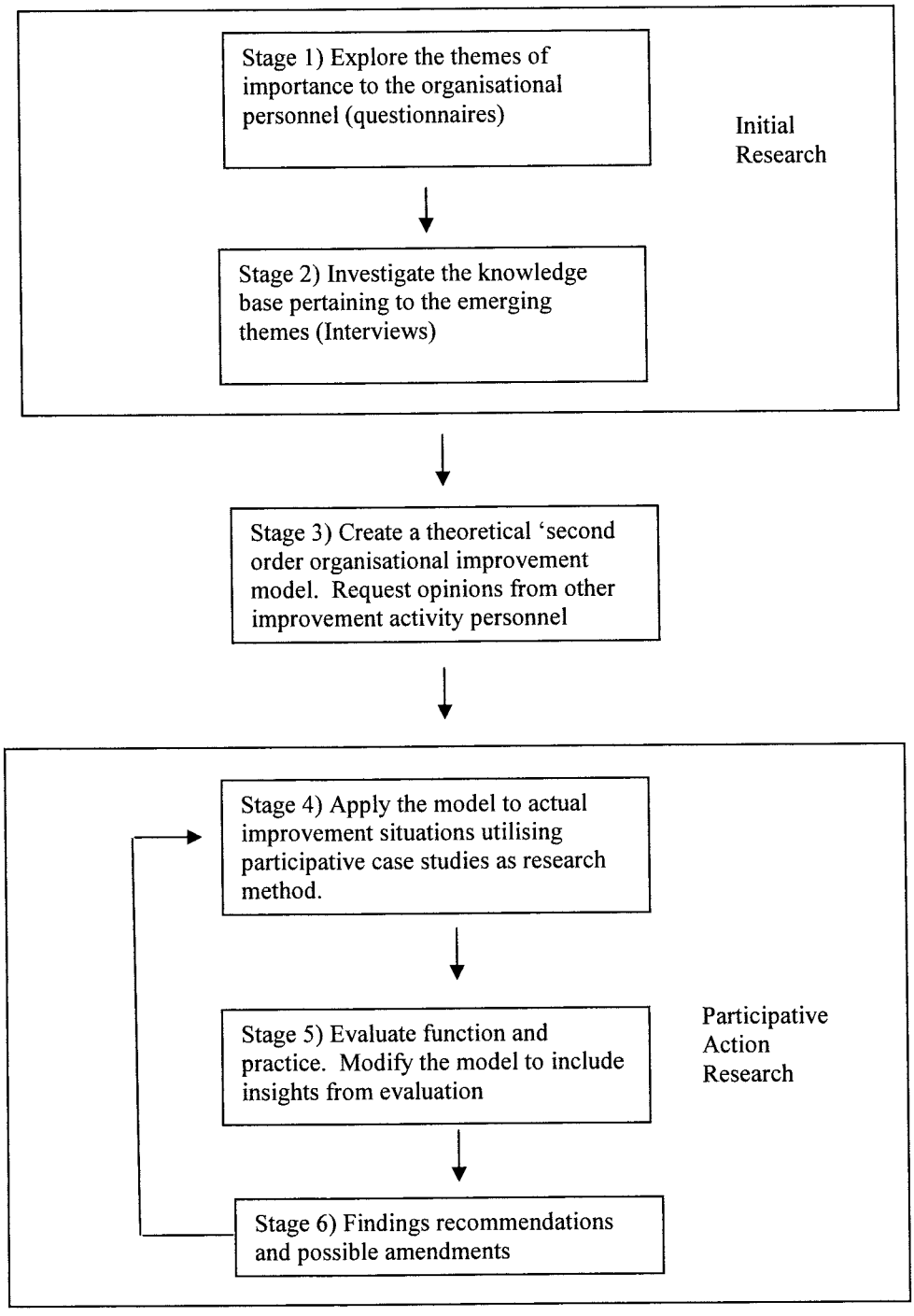

Figure 3, Second Order Process Development

As depicted in Figure 3 the research followed a linear path until the action research phase. At this point, several iterations took place to develop the process from a theoretically based

process to one based on a combination of theory and practice supported by workshops to explore and develop systems thinking and dialogical skills within personnel engaged in organisational improvement.

2.3 METHODS USED

2.3.1 Questionnaires

Questionnaires were used on two occasions. The first use was as a component of the initial investigations, developing of a number of themes of interest to the workforce of Northumberland Manufacturing, as a means of gathering information to gain a wider understanding of the thoughts of the workforce on the subject of the proposed 'Time and Attendance System'. Questionnaires can use open ended or closed ended questions. Likewise, the questions dictate the forms of analysis used. Closed questions are normally associated with quantitative research. Responses can be analysed mathematically. However, the questionnaires used within the research used open questions. Open questions collect qualitative data usually in the form of a narrative and analysed using content analysis. Both questionnaires are discussed in their respective chapters under the headings of initial research analysis and case studies and will not be discussed further here.

2.3.2 Informal Interviews and Discussions

Informal interviews and discussions with improvement groups were one of the tools in the collection of empirical data. The main purpose is to explore the everyday experiences of those involved in organisational improvement. Such a phenomenological perspective seeks to investigate experiences through the lenses of those interviewed. The understanding sought, is how individuals actually understand situations in everyday commonly used organisational language. Semi-structured interviews and unstructured discussions, where individuals express their opinions around open questions were one of the principle methods of data collection. This form is used to minimise researcher presumptions, still as has been stated, inbuilt researcher presumptions cannot be totally

eliminated. It was also important that the themes developed from the initial questionnaire and subsequently from interviews arose from the data collected and not imposed from the researchers' perceptions. The intention was to identify and understand the experiences of those interviewed. It was a subjective enquiry in search of people's experiences. Such attempts to describe and understand individuals' subjective experiences Crotty (1998) describes as *"putting oneself in the place of others."*

2.3.3 Seminars and Workshops

Several workshops took place in order to explore the use of 'Systems Thinking' and the implementation of the second order process. These workshops were lead by invited consultants, who demonstrated and worked through particular disciplines, with this researcher acting as an observer of the individuals taking part in the workshop. For the development of systems thinking, it was imperative a systems approach was not visualised as an academic exercise by those taking part. In order to achieve this objective an extended improvement group formed to conduct a dialogue session, thereby highlighting a number of issues they thought worthy of investigation. The group identified several issues, including general lack of communication. Following discussion, the contract review procedure became the subject of investigation. Appendix B contains the paperwork produced during the systems workshop. This researcher acting as both a team member and researcher had a twofold aim. Firstly as a team member, it was to assist other members of the company to move from the use of the first order Problem Solving Process to second order systems in organisational improvement activities. Secondly as a researcher, it was to observe the journey from first order to second order understanding. During the systems workshops, a software package introduced as a tool to assist in developing an understanding of the systems and issues under investigation proved successful. The package (Organisational Performance Improvement and Understanding Method) (OPIUM) was designed to help organisations determine and achieve improvements through systems

thinking and practice (Sawyer & Gammack 2004). The package became a preferred tool by improvement teams, when constructing systems diagrams to aid the visualisation of a systems components and their interaction. Taken in their entirety, the series of workshops provided a basic grounding in systems principles amongst those taking part. To the individuals concerned the workshops gave substance to systems thinking theory, allowing theory to be mapped and subsequently applied to actual situations of interest. While the software gave teams a graphical representation and focal point during dialogical discussions of the system.

2.3.4 Participative Observation and Action Research

Questionnaires and interviews are useful in identifying issues of importance. However to enact change as was required in developing the second order process, more than could be achieved from questionnaires and interviews was required.

Therefore, the research route chosen following the initial investigations and development of the research themes was participative action research. Action research, defined by French and Bell (1984), as systematically collecting research data about an ongoing system relative to an objective or need, proves extremely useful in managing change. Essentially, the authors maintain action research involves

- Taking a static mental picture of the organisational situation
- Forming a hypothesis based on the picture
- Manipulation of variables under the control of the researcher
- Taking and evaluating a second picture of the situation
- Reiterating the above steps until the change required has been accomplished

Action research is therefore involved in a real manner in organisational improvement situations, where there is an expectation of a contribution to knowledge applied and validated in action (Gummesson, 1991). While this form of research provides the

researcher with quality access to the change process, the cooperation of company personnel is crucial. The requirement for the researcher is the ability to combine the role of a team member and observer.

Action research, usually involves small scale interventions from the researcher in the phenomenon studied. In such a paradigm, the researcher is actively involved with the situation being studied (Aguinis, 1993; Ledford & Mohrman, 1993). In such research, it is important for the researcher to recognise his or her impact on the situation. Additionally, action research can require a considerable amount of time and is unsuitable for short-term projects. As the research into the development of the second order improvement process took place over an extended period. The time for the detailed research required in developing the second order process was not a problem. As a company employee and researcher, the presence of this researcher within improvement groups, did not pose the problems of individuals changing their normal reactions, as is often the case with external observers. However, the other members of the groups, who became the subjects of the observation, were made aware of the research process. Accordingly, the research and development of the second order improvement process, took the form of a series of participative action research observations of improvement activities. Consequently, each case study provided information that then became available to direct process amendment if required.

2.3.5 Case Studies

Case studies to the social scientist are the equivalent of the experiments of natural scientists (Kasanen & Suomi, 1987; Smith, 1990). Yin (1989) claims that "*a case study from a research strategy point of view may be defined as an empirical inquiry that investigates a contemporary phenomenon within its real life context*". This definition fits the participative observations conducted as a series of case studies during the development

of the organisational improvement process. The term case study according to Bell (1993) has been used to encompass a family of research methods, having the commonality of focusing on enquiry around a specific instant or event. This was the case with the research leading to the second order organisational improvement process. Philosophically, using case studies, the researcher is able to look closely at practical real life situations. For that reason, case studies allowed the formation a rich picture of the interaction of individuals and events. The use of case studies allowed this researcher to concentrate on the interaction of individuals' and the differing interpretations of the stages of the model. As a result, it was possible to develop an understanding of the interactions, relationships and resolution of issues arising between differing views and patterns of influence.

2.4 SUMMARY

The purpose of this chapter has been the creation of a methodology to fulfil the requirement of the research. This requirement is for the creation of a cooperative people based approach to organisational improvement entitled a 'second order' improvement process. Such research lends itself naturally to a participative approach, where the researcher becomes part of the improvement team in order to observe the interactions and team dynamics of those involved. This moves the researcher from a passive observer to an active member of the team able to affect outcomes. Taking the research method one-step further moves into the realms of case studies, where the researcher not only participates but also directs and or alters the parameters of the improvement activities. Therefore, action research became the vehicle employed to direct improvement team activities in the development of the process.

However, in order to make a clear judgment of the themes and issues of importance to the individuals employed within Northumberland Manufacturing, qualitative interpretive and Inductive approach were used to collect and analysis initial date. These approaches are primarily employed to surface key themes within textual data. However, as Klein & Myers

(1999) points out interpretative research will by its nature, be knowledge gained through the filter of the social constructs of the researcher carrying out the analysis. Such qualitative interpretive and inductive approaches were utilised to collect and analyse questionnaire and interview data to develop key issues and themes of concern to the workforce of the organisation where the research was carried out. The methods, the approaches used, analysis and the findings are the subject of the next chapter.

3 CHAPTER 3: INITIAL ANALYSIS

This chapter has as its aim the examination of the approaches and analysis of the initial research undertaken to establish the general direction of the main research. The reason for the initial research is the establishment of the key areas and issues that will gain the interest of the individuals within the researched organisation. Being able to establish the issues considered important to the individuals of the company, allowed the direction of the following research into those areas, thereby addressing actual rather than theoretical issues.

3.1 APPROACH TO INITIAL INVESTIGATIONS

The purpose of the initial research was to explore the existing social environment and develop themes and issues deemed important by the respondents and interviewees. This gave validity of the philosophically based empirical assumption, that the implementation of a second order improvement process was possible. Thus, developing an understanding of how individuals perceive and act in organisational situations. Therefore, a qualitative interpretive and inductive approach is applicable.

The research took the form of an initial questionnaire. There was a response of thirty-four from a distribution of seventy, followed up by a series of eight semi-formal interviews. This researcher selected the interviewees from the general workforce. Both the questionnaire and interviews utilised the same set of five questions as shown below:

1. What is it that you enjoy about your work? For example, the people, interesting work training opportunities etc.
2. What is it that causes you dissatisfaction, stress unhappy experiences?
3. What do you think should be explored, looked at and improved?
4. Are quality standards, clear easily understood and available (If not why not)?

5. In your working day, do quality issues affect you (quality in its widest sense such as incorrect components, late delivery, unavailable information etc, in fact anything affecting your ability to do your work)?

In addition to the above five questions a sixth question was added to the interviews. The sixth question asked the interviewee to imagine an ideal organisational world and think of what improvements would move things closer to this ideal world.

Inductive research condenses extensive textual data into a brief summary. The purpose is to allow research findings to emerge from the dominant themes inherent in raw data. Inductive research has as a main concern, the identification of a number of themes within the data. The primary mode of analysis is the emergence of categories into key themes and processes, judged important to the individuals supplying the data (Thomas, 2003). Bernard (1996) points out when a researcher conducts qualitative analysis he or she interprets it. In order for the findings to be of use, the data analyst must make decisions as to the importance or unimportance of the themes contained within the data. Inevitably, those decisions will shape the findings in line with the assumptions and experiences of the individual conducting the research.

Klein & Myers (1999) have described interpretative research in epistemological terms as knowledge, gained or filtered through social constructions, such as language and shared meaning. Underlying interpretative research is the assumption that reality is a social construct and acknowledges there is a relationship between the researcher and what is being researched. In terms of methodology, interpretive research does not predefine principles; the aim is to produce an understanding of the social context of the phenomenon and the process at work that influences and in turn are influenced by the social context (Walsham, 1995).

"An interpretive paradigm is based on the view that people socially and symbolically construct their own organizational realities" (Berger & Luckman, 1967)

The research approach, accordingly, is consistent and compatible with the epistemological and ontological assumptions that people in the context of historical and social practices interpret the world and reality. That is, experience of the world is subjective and best understood in terms of individuals' subjective meanings, rather than the researchers objective definitions. To summaries the emphasis of the approach to the initial research was on the interpretation of the questionnaire responses and interview transcripts. From this initial research, an emergent understanding of the important issues and environment within the organisation as seen by the questionnaire respondents and interviewees could be developed.

3.2 HORIZONTAL AND VERTICAL ANALYSIS

The questionnaire data analyzed vertically and horizontally, brings to the surface a number of common themes of interest. Reading horizontally, means reading each question from the questionnaires in turn. For example, the questionnaires in the initial research survey contained five questions each and there were thirty-four responses. Therefore, horizontal reading of the questionnaires entails examining all of the thirty-four responses to each question in turn. In this way key issues and themes, emanating from each question, are established. Following examination of the thirty four answers to question one, question two is likewise examined then each question in turn until all five questions have been covered. Following the horizontal reading, comments from each question are grouped into question themes. Vertical reading means reading question answers from each questionnaire in isolation. In this way, the issues of concern to each individual will become apparent. Once both horizontal and vertical reading is complete, the analysis is cross-referenced and amalgamated into groups (Marshall, 1999). The combination of vertical and horizontal analysis is used as an indicator of the issues deemed collectively

important to the individuals within the organisation (Marshall, 1999). Following the emergence of a series of themes from the questionnaires, the interviews developed into conversations to explore these themes in deeper contexts. Thus, the primary findings are deduced from both the overall research objectives and emergent themes arising directly from the analysis of the raw data.

3.2.1 Questionnaires

Seventy questionnaires were distributed to staff from both the Compressed Air Breathing Equipment (CABE) and Fixed Gas Detection Systems (GDS). Examples of returned questionnaires are located in appendix C. The combined total number of employees within the researched organisation at the time of the questionnaire was three hundred and fifty two, sixty-seven from GDS and two hundred and eighty five from CABE. Consequently, in order to be able to gather the data as efficiently and with as little disruption or inconvenience as possible, a poll from a selected number of individuals was undertaken. Having decided to poll a proportion rather than all staff, a decision was required as to how to select individuals in order to produce a representative sample. In answer to this question, a proportion of twenty percent from each department covering all levels from managers to operators were selected, fifty-six from CABE and fourteen from GDS. This gave, in round terms, a distribution quantity of seventy, with twenty percent from each department providing a proportional representation from all areas of the organisation. From the seventy distributed thirty-four replies were received, ten from GDS and twenty-four from CABE.

One of the first findings that became evident from the returns was the difference in the percentage of responses from the two divisions: GDS and CABE. Ten replies received from GDS, represented a response rate of seventy-one percent as compared to twenty-four replies from CABE, a response rate of forty-three percent. This large differential response

rate between GDS and CABE is possibly an initial sign that individuals from GDS are more willing to share their opinions with others. Nevertheless, the response rates from CABE still represented a general willingness to share thoughts and opinions.

A second general observation made was that of the thirty-four responses, five were very negative, with the remaining twenty-nine being either neutral or positive in their responses. Among the negative responses were comments such as:

> *"Work is a necessity therefore I do not enjoy it".*
>
> *"Coming to work causes me dissatisfaction".*
>
> *"I enjoy nothing in my work".*
>
> *"Coming to work makes me unhappy".*
>
> *"I am unable to identify anything I can say I truly enjoy at work".*
>
> *"The only thing I enjoy about my job is the people I work with and getting paid at the end of the month".*
>
> *"The way some of the bosses stab you in the back to keep themselves out of trouble. This can cause some people a lot of stress".*

While some responses to individual questions were not conducive to a cooperative approach and seemed to indicate negative opinions, they were contained within a much larger generally positive response, which in the main was supportive of a second order approach. The five overall negative responses represented fifteen percent of the polled individuals; therefore, a significant proportion of staff appeared to be dissatisfied with the situation at the time of the questionnaire. Yet, that the individuals took the opportunity to respond is an indication of their willingness to express their thoughts and cooperate in attempting to improve the situation. This itself is a positive pointer towards a communicative sharing environment even if, or more importantly especially if, those thoughts are at times negative.

Of the remaining twenty-nine positive responses, the following quotes from the questionnaires indicate the general tone of the responses

"In my workplace I enjoy the company of my work colleagues. I find the atmosphere enjoyable, yet rather demanding. And I also find the training opportunities are very satisfying".

"Every day is different, constantly meeting new challenges, the support from other colleagues constantly learning and the training opportunities are always there

"The people I work with are the most enjoyable. It helps to get on with your colleagues as this leads to a happy working environment. The work is demanding but interesting but the rewards are worth the demands. Northumberland Manufacturing training opportunities are good and I think Northumberland Manufacturing acknowledges anyone wanting to better themselves".

"I enjoy helping people to develop. Both in their ability to do the job more efficiently with the use of machinery and improved process control & to expand their own skills & horizons. This is where teamwork trust and honesty come into play"

"I enjoy the work that I have to do most of the time as I feel confident that I can do it. I also like taking on new tasks that may be a bit more challenging or different, something to think about. I do not like it when people are abrupt or impolite when they need assistance; it makes me less likely to be as helpful as I could be, although this does not happen often".

"Workmates who are there for you in good and not so good times.

"I have a good relationship with my workmates. My job has day-to-day variation, which makes it interesting. "Impossibly tight deadlines and the attitude of some workmates cause dissatisfaction".

"The variety of work in which I am involved. It is all linked with work measurement in some way, but there is still a variety of inputs. E.g. Routings and developing a database involves PC work, the HUB project involves creating methods of work and work instructions. Projects such as obsolescence or make or buy have a more general input"

"Not being able to complete my work when I want to or not being able to do justice to it because of time restraints causes me dissatisfaction".

The above typical responses represent the types of comments made within the questionnaires. The underlying theme, points to the possible existence of a cooperative sharing social environment. This is borne out by the high proportion of positive responses, with many responses being indicators of the attitude required. From the above examples, one directly refers to the need for honesty and trust within team working. Another puts value on workmates who stand by each other in bad as well as good times. Two of the above quotes indicate that in their opinion the people they work with are an important factor in making work an enjoyable experience; this is a theme mentioned in twenty-four

responses. With the addition of eighteen separate mentions of team working, this is a leading theme that emerged from the survey.

Analysing the data lead to the emergence of seventeen sub groups of comments. These sub-groups ranged from, 'work processes and systems' mentioned twenty-seven times, to 'leadership from the top' receiving only two mentions. Following the twenty-seven identified references to work process and systems was communication with twenty-six and generally working with colleagues with twenty-four. Table 1 shows these subgroups and the frequency of how often they were mentioned.

Table 1, Reoccurring Themes from Questionnaires

Initial Theme Sub Groups	Number of Occurrences within Questionnaires	% Occurrences
Work Processes and Systems	**27**	**11.9**
Communications	**26**	**11.5**
Working with Colleagues	**24**	**10.6**
Interesting and Varied Work	**20**	**8.8**
Quality Issues	**19**	**8.4**
Team Working	**18**	**8.0**
High Work Load	**15**	**6.6**
Training and Learning Opportunities	**13**	**5.7**
General Working Environment	**11**	**4.8**
Stress	**9**	**3.9**
Having to Fill in for Others	**9**	**3.9**
Lack of support / no trust in Managers	**9**	**3.9**
Equality across departments	**7**	**3.0**
Peoples Attitudes	**7**	**3.0**
Job Rotation and Clear Roles	**6**	**2.6**
Unhappy Experiences	**4**	**1.8**
Leadership from the Top	**2**	**0.9**
Total Theme Occurrences	**226**	

Subsequent repetitive readings of the data amalgamated the sub groups into a smaller number of themes. Themes emerged from the study of responses and the consideration of their possible meaning from horizontal and vertical reading analysis.

The aim of repeated reading and combination of horizontal and vertical groups is the reduction of sub-categories into between three and eight main themes as advised by

Campbell et al (2003) and Jain and Ogden (1999). At the end of the analysis four main themes had emerged these were:

- Processes and systems
- Communication issues
- Relationships and team working
- Work variations and load

The above four themes derived from the amalgamation of the sub groups will be outlined briefly below. The ordering below does not indicate any order of importance.

Processes and systems

This theme of processes and systems mentioned directly on twenty-seven occasions and indirectly within many other replies was prevalent as a leading point of importance. In general, the respondents used the words 'processes and systems' in an interchangeable fashion. The points made, primarily revolved around the area of system failures or the possibility of system improvement. For this analysis, the many references to training have been included under this heading and viewed as the training systems of the company. In essence, the message emanating from the analysis was that all systems were capable of improvement, while some required attention at the earliest possible opportunity, especially those of communication and information flows.

Communication Issues

The second of the four areas of importance within the data is communication. Comments centred on the lack of or poor communications. This theme originated mainly from the questions covering the respondent's thoughts on possible areas for improvement. However, communication did figure in other areas of the questionnaire answers. Communication is an underlying essential aspect of the second order understanding of others. To come to a second order understanding of others, language and communication are essential tools. The language and terminology used within the organisation caused

some concerns, especially from non-manufacturing departments. These concerns covered the imposition of a language and terminology used within the manufacturing department on other departments, irrespective of the suitability and the understanding of that language to individuals in non-manufacturing areas of the organisation.

Relationships and team working

Relationships with others and working as a committed member of a team, is an important theme in respect to the overall action research aim of developing a second order people based approach to organisational improvement. The tones of the responses on this issue were in the main conducive to the overall aims of the research. The recurring message of this theme was, that individuals found working with others one of the most pleasurable aspects of organisational life. The importance of relationships cannot be sufficiently emphasised in the successful development and implementation of second order improvement. A second order improvement process grows from harmonious trusting relationships. Relationships must exist that allow individuals to disagree with each other, without risking a confrontational environment developing. The responses covering this theme are extremely encouraging and indicate that second order relationships are not only possible but also desired by a large proportion of the workforce. In contrast, the relationship between middle managers and the workforce, did have a number of negative comments with a lack of trust and the view that managers do not listen to the opinions of the workforce coming to the surface

Work variation and load

In answer to the question, what causes distress and unhappiness? In the region of fifty percent of the replies specified high workload and tight deadlines as the main causes. The reported effects from high workload included, supervisors having to work as production and assembly staff, thereby not being able to carry out their own work, resulting in backlogs and a primary cause of stress. However, many respondents while commenting on the high workload also considered their daily work both interesting and varied. It was

common to have both remarks on work variation and workload within the same set of replies. The issue of high production targets proved to be an issue affecting improvement activities. Indicated by the identification of the subject on several occasions as a major factor in restricting team leaders' and other staff the opportunity to take part in improvement teams'.

Table 2 outlines the findings of the questionnaire analysis. The chart shows the number of times each theme has occurred. It emerged, that, any individual questionnaire could provide references to several themes and to any one theme more than once. While there were, thirty-four returns a theme could be mentioned any number of times.

Table 2, Outline of Questionnaire Analysis

Emerged Themes	Sample Quotes from Questionnaires	**Occurrences**
Processes and systems	"Northumberland Manufacturing training opportunities are good and I think Northumberland Manufacturing acknowledges anyone wanting to better themselves" "There are a lot of processes which need to be looked into and streamlined" "With the work I do any problems accessing severs, drivers or Lotus Notes on my PC and I can complete very little" "Enjoyed the training but no opportunity to take it further" "Make all components in house for better control" "Technical support there should always be someone in customer service to cover technical questions" "Increase skills base in electronics in other departments"	48

Emerged Themes	Sample Quotes from Questionnaires	**Occurrences**
Communication Issues	"Late delivery and unavailable information are two of the most common problems" "Better coordination of project work across the site is required" "PC based quality systems can be confusing" "Communication with other departments" "Define job roles, fully understand what is expected" "Too much variation in quality standards no clear standards" "Not being kept informed about my own teams" "Communication between staff and employees" "Better information resources on customer requirements" "Having to wait for language translations causes stress" "Unavailable information"	50
Relationships and team working	"The people I work with are the most enjoyable. It helps to get on with your colleagues as this leads to a happy working environment" "The ways some of the bosses stab you in the back to keep themselves out of trouble. I think the fear factor is still here" "I work with a very dedicated team of people" "One people one voice knowledge management philosophy starts at the top" "Not being trusted not being listened to" "There are too many people who are only too happy to look or go the other way when you need help" "The quality team are on the ball all the time Quality is one part of my job I never fall down on cause quality team are there immediately" "Lack of trust from my supervisors" "The negative thinking of some people, people do not want to be criticised constantly" "I enjoy being involved with ongoing continuous improvement "	82

Emerged Themes	Sample Quotes from Questionnaires	**Occurrences**
Work variation and load	"I find the work enjoyable but rather demanding" "Impossibly tight deadlines" "Work load, my team are sometimes overloaded by six to eight hours" "Interesting work that changes from day to day" "Work load placed on you at short notice" "Give more time to complete work fully" "Not able to do my job as cell leader as I have worked on the line as an operator for the last three months" "Being expected to have five pairs of hands and people not realising that we only have so many hours in a day" "Work overload due to sickness of others and staff shortages" "I have been getting very stressed lately due to staff shortages and work not getting done" "Give more time to complete work fully"	46

As Table 2 shows, relationships and team working figured highly in the responses with the majority of comments indicating that working with others is a positive experience. Nevertheless some comments did question the motives of others, for example the comment "*There are too many people who are only too happy to look or go the other way when you need help*" as shown above. Yet, the general direction is that people find working with others a positive experience, and that working in teams is conducive to improvement activities.

The positive message from the theme of work variation and load was that the variation in day-to-day work is one of the things that give interest as the following comments show: "*Interesting work that changes from day to day*" and "*I find the work enjoyable but rather demanding*". However people went on to say, workload was a problem and that a high workload had a significant contribution to the high stress levels.

The answer to the initial primary research question of whether the environment within the research organisation was applicable to the development of a people based second order improvement process or not is most certainly 'Yes'. The indication from the responses and

the emerged themes is one of people being willing and actually enjoying working together in improvement teams. While in some quarters, trust is certainly an issue; the overall level of trust within the organisation is such that people are willing to exchange thoughts in a candid manner. While having established that there is a degree of dissatisfaction and distrust within the company, the overall emergent picture is one of trust and commitment to team working. This finding validates the initial belief based on empirical evidence that it would be possible, as well as desirable, to develop a second order improvement process within the organisation. The research having developed the set of themes of interest from the questionnaires, moved on to the interview phase.

3.2.2 Interviews

Following on from the questionnaires, a series of eight interviews were held to gain a deeper understanding of the themes. Example interview transcripts are supplied in appendix C. The individuals chosen, with one exception were from the manufacturing operations department. The representatives covered a cross-section of the department including a manufacturing manager, supervisors and technical engineers, all who in their daily activities would be involved in action based improvement projects. Each of the interview transcripts was analysed to gain further insight into the beliefs, assumptions and prejudices of people who would be participants in organisational improvement groups. Preceding each interview, this researcher requested, the interviewees give their own opinions and not the company line. As a result, the interview answers and comments do not represent company policy but the beliefs and opinions of those taking part in the interviews.

3.2.2.1 Interview 001

Interview 1 took place with the manufacturing manager who was responsible for all manufacturing and assembly facilities within the company. This manager had been with the company for many years and as he said, "*I have moved across the different*

departments and boundaries. I have been involved in lots of areas". Additionally he goes on to say that, one of the things he enjoys is becoming involved in many areas and that in his opinion, people are always willing to talk to him. In considering the preceding ten years, the conclusion he draws is that a considerable movement towards an open and communicative environment has taken place. However, he does make the statement that while at times it seems things have not changed, on reflection "*it is a totally different place from what it used to be".* The comment shows the direction required for the aim of developing a people based open and sharing improvement process. Considering environmental issues, the interviewee comments, "*I would love to get an environment where we aren't fire fighting, we aren't chasing our tails, we have problems created by ourselves".* This and other comments reflect the workload theme as being a leading concern. Looking at processes and systems brought the thought, that most of the processes within the assembly area had a problem typified by the following remark, "*I sat one day and looked at every flow line and I did not have a product that didn't have a problem somewhere".* Delving deeper, brought out several areas the interviewee thought would benefit from the attention of improvement, ranging from general product design, to the equipment in use and the supply of external components. Nevertheless, this manager did hold the belief that processes had improved over the last five years and that the product was being built in a "*much more 'professional and efficient manner*". Additionally, he held the opinion, that the organisation lacked a clear strategy with regard to the forward direction of the company. This was made abundantly clear by the following quote, "*I think the other big one for me is the lack of clear direction and clear strategy, where are we going as a company, where are we going as manufacturing. Do I look towards investing in the machine shop or are we going to ship out products and services. There isn't a clear stake in the ground".*

On the theme of communication, this individual believed that the situation existed where almost too much information was available. A questionnaire respondent from GDS, who commented on available quality standards supported this opinion, with the following quote, "*working in sales is totally different from manufacturing we all have quality standards but a manufacturing quality standard for a Lung Demand Valve is meaningless to me*". The general communication concern was not the quantity but the quality of information communicated. Another common communication issue that this interview touched upon was the need for improved interdepartmental communications. Elaborating on the point in connection with new products, he said that in his opinion it would be beneficial if people were able to understand, what was happening at an earlier stage than at present.

When discussing relationships and team working, the overriding theme was one of cooperation between individuals and departments. Coming out strongly was the opinion that people now have the trust in each other to be able to express their opinions. This view, expressed in several points throughout the interview was a central thread and gave a positive bias to the overall opinions and beliefs expressed. While looked on in isolation, some of the statements and remarks with the interview seem discouraging. On the other hand, when examined from a holistic perspective the impression given by the interviewee was optimistic. On several occasions while explaining the problems and difficulties, he faced in his working life, he emphasised the improvements in the areas of relationships communication and professionalism he has witnessed in the preceding years.

When asked what in his mind was the one thing that would improve his and other peoples working lives his reply was, "*a clear philosophy and strategy or whatever as to the way we need to go. Give us the tools, the environment, decent praise every now and again, let us*

see where we are going, and give us some visibility of what is expected and where our place is within the company and people will be happy".

3.2.2.2 Interview 002

The second interview, conducted with a team leader from the CABE assembly area, took place a short time following her move to a new position of team leader in the Breathing Apparatus assembly flow line. Her answers reflected the move and her unease in the situation. One of her first comments was that she liked to be in control, meaning she was still not sure of herself in her new position. While discussing communications, the interviewee made the point that in her new position she shared responsibility for the area with another team leader; however, they failed to communicate effectively. Her comment was, "*There might be some aspects of the line I don't find out about. Because people go to Marge and we do not have the time to communicate. She forgets to tell me and I forget to tell her".* Still, she did think the morning communication meetings with other team leaders and the section supervisor was helpful in defining the priorities for the day.

When discussing relationships, this individual held the opinion she was not perceived as part of assembly management. When asked if this perception originated from managers or operators, she answered, 'both'. In spite of this, she did express the opinion that people were more than willing to participate in improvement activities such as Kaizen. Speaking of process improvements, she made the following observation, "*When people come up with ideas they feel involved*". Asked about drawbacks, she replied that the opportunity for participation in improvement activities was severely restricted due to the workload placed on the flow lines.

All of the themes that emerged from the questionnaires also emerged during the course of the interview. Overall, the interview analysis confirms the findings from the questionnaire.

Communications referred to in both positive and negative terms formed a central thread of the interview. Processes and systems played a recurring role with comments such as, "*I know people would like to have involvement in everything that goes on around them*". This comment, made when discussing teamwork and the actual people who work on the assembly lines taking ownership of improvement activities also displays people's willingness to share ideas. This is exactly the environment required for second order understanding

3.2.2.3 Interview 003

This interviewee had only been with the company for a year and therefore provided an opportunity to consider the opinions of an individual relatively new to the organisation. His initial reaction to the question of what makes his job enjoyable was the people, their enthusiasm, calibre and willingness to take on the challenges put to them. Comments such as, "*It is the people side I am getting enjoyment out of at this point in time,* and *"I enjoy the interaction between people"* are typical of this point.

When discussing workload, the message was again one of high targets attained only through the willingness and efforts of the people in the assembly role. His comment, "*I try to get the message across that we haven't got the manning that's required to do the job we have been asked to do"* indicted his concern. However, when asked how in that case the section achieves its targets he replied, *"The only reason we can do it is the quality of the people we have out there. They really care about the quality of the product they make and their product knowledge is second to none"*. Going on to discuss his thoughts on the role of the team leaders, he agreed with the opinion of interviewee two, the role required redefinition and development. He, like interviewee two, thought that in the recent months the workload had required team leaders to spend the majority of their time actually functioning as assembly operators.

Moving to the theme of organisational improvement, the message was that the team leader should be taking the lead in this area with the following remarks. *"Team leaders need to be allowed to drop back and look at the wide picture and say what needs to be done to improve the section. In addition, what I think would be worthwhile would be to implement some activities on each flow line where we get the operators involved in improvement teams as well."* These thoughts link to improving the general environment for the people within the organisation. Expressed in this and the following way, these comments indicate a high propensity towards second order thinking and point positively in the direction of the willingness to develop a second order approach within the assembly area. *"It is not just about getting product out; it is trying to make it more enjoyable for everyone. Allowing people to move away from production for whatever time is required to sit down and say what we need to improve, what are your ideas and how can we implement them. But it's getting the time to do it, time."*

When considering the theme of communication, this individual believed communication at all levels required improvement. Discussing communication at a general level, his opinion was that some documentation was not sufficiently user friendly. *"Some of the quality tools like standard operation sheets are not very good at this point in time. If you look at the format that we are using it could be made a little more user friendly. People that compile them, primarily the cell leaders or industrial engineers, use the same format they have been using for years"*. In addition to this, the interviewee held the opinion that little or no feedback is given to operators following suggestions made by them. Furthermore, a lack of recognition was also a concern. *"I have had a few comments on kaizen improvements and people have had no feedback whatsoever. I would like to get a bit more feedback going, if people raise an idea I would like to make sure it is investigated fully. If it is a non-starter fine, but give the feedback as to why it is a non-starter. If it is going to*

improve things, they should get the recognition they deserve. I think the average operator out there from that respect feels pretty badly done to". These comments are important to the implementation and operation of people based approaches. Feedback to people making ideas is vital, without feedback people will simply stop making suggestions, thinking their opinions do not matter.

The overall impression gained from this interviewee with respect to second order organisational improvement was, 'optimistic enthusiasm'. While he raised several concerns regarding workload, feedback to operators and other issues, such as the team leaders' roles and responsibilities, none of these in his opinion were insurmountable. On the contrary, his belief was that improvement of these issues was more than possible, especially with the willingness and product knowledge of the team leaders and operators in his area and the company as a whole.

3.2.2.4 Interview 004

The fourth interview was with the company's electrical engineer, who had been with the company for sixteen years at the time of the interview. His main role was in the development of electrical circuits for use in test or assembly equipment that supports the manufacture and testing of components. When asked what he enjoyed about work his reply was simply, *"everything"*. When asked to expand on his answer a little he replied, *"I am now more involved with Jim and some of the other industrial engineers when they are involved with new or upgrading old machinery. I am very interested in the work and I enjoy working with the people I work with, I enjoy meeting people and talking to people on a technical level"*. The interviewee went on to say, that he thought he worked with a close team of engineers and other technical people, whose main task was to improve the productivity of the organisation. His concluding remark on this subject was, *"the main answer to your first question is I am very happy and I am very happy with* Northumberland

Manufacturing. *I do enjoy working for them and in my mind Northumberland Manufacturing is a good company".*

When asked what he disliked about work, he replied that one of the biggest annoyances to himself were people who in his words, "*try to waffle or bluff their way through a job"* pointing out that this is a common occurrence within industry generally and that he had come across such people within the company. Commenting that this was only his personal opinion, he concluded that such individuals tend to blame problems they encountered on areas or individuals they themselves are not responsible for, thereby shifting the burden away from themselves.

On communications, his main concern was misinformation given to senior management, or as he put it *"people simply telling management what they thought they wanted to hear*". His comment was that in his personal opinion, "*senior management were deliberately given so much incorrect misleading information compared to the information they should have been given".* He also commented that, *"Managers or departmental heads have told the senior management what they wanted to hear, and not given a true reflection of what was going on in the area where it was happening".* Concluding that if anyone tried to correct any obvious misinformation he or she is told clearly that it was not his or her job and none of their business. The interviewee said that apart from that, he found the communication between individuals he worked with was very good.

One of the areas that did not merit a mention in this interview was workload. This interviewee was the only individual that did not consider his workload at a higher level than he would like. When discussing the processes and systems he would like to see improved, his main thoughts were towards automation whenever possible. His reply on this issue was, *"I would like to see automation come in. I have spoken on this subject to*

the industrial engineers before, it is a difficult process to automate anything here; we are semi- automated in some cases. I would like in the very near future to see higher tec machinery but then again it has to come from management".

On the subject of relationships with others, the comment, "*I am a strong believer in giving respect to everybody, I think you need to give respect to gain respect"* sums up the opinion of this person to his dealings with other individuals. The general tone of the interview was one of enthusiasm and a willingness to cooperate in team based improvements. Comments along the lines of, "*In my personal opinion we work as a very close team"* and as he himself puts it "*I enjoy working for the company, I enjoy my work and the people I work with*" reflects the overall upbeat tone of the interview

3.2.2.5 Interview 005

This interview was held with the company receptionist, who under normal circumstances does not take part in organisational improvement. Nevertheless, the interview was useful in gaining an understanding of the views held by someone not normally directly engaged in the manufacturing process.

Her initial remark about her job was, "*I really, really like the job I do, I really like meeting people".* When asked about being the first point of contact for visitors to the company, she commented that it was a chance to meet people and that you do become friends with some regular visitors with the following response. "*The first point of contact 'Yes', people get used to you, obviously and call you by your first name. You get used to them, I know if I see them on the street, I would say 'hello'".*

The aspect that made her unhappy in her position was, as she put it, 'a lack of communication'. When asked to expand she replied that people were supposed to inform her when they would not be on site, but frequently did not. She also pointed out that when

people visit the plant they have to book in and out through her and that this requirement was frequently omitted, especially when leaving. She comments that she asks company personnel to make sure visitors sign out, making the following quote; *"I ask people, will you please bring your visitors back to reception when they leave, but a lot of them just don't, it's not always the visitor it's the host. They know the rules and a lot of them don't like abiding by them"*, makes the point clear. The interviewee pointed out that this was an important issue having safety implications. She explained, in the event an evacuation of the site we could have rescuers looking for visitors who have already left. This would put lives of rescuers' in danger needlessly. When discussing processes, she maintained it was not the process but the people not using them correctly that caused the problems affecting her.

Again, this interview highlights the fact that working with other people forms a major part of what people find interesting in their daily activities. This general condition is an indicator that a people based approach to organisational improvement is applicable in the case of this company.

3.2.2.6 Interview 006

The sixth interview, was one of two interviews with members of the industrial engineering team. The interviewee had been with the company for approximately five years at the time of the interview. The role of an Industrial Engineer within the organisation is to examine current manufacturing processes with a view to improvement with new technology, or new methods of working. The industrial engineers also have a leading role in the development of manufacturing processes and practices, as part of the development cycle of new products. The industrial engineering role is the primary reason for the selection of two individuals from this department, as it is one of the leaders in manufacturing improvement activities.

When asked what makes him happy in his work this interviewee's reply was, "*what makes me happy is to find solutions to problem situations you might have as an engineer*". On further discussion of problem solving he made the comment, "*it makes me happy that I get feedback from the people that use the equipment I have designed, that they find it easier to work and the production numbers go up*". Thus, this is a reciprocal loop of improvement, feedback and refinement. When discussing communication within the industrial engineering department, he maintained informal meetings are utilised. As explanation, the engineer said; "*Generally as part of a small department we have discussions, open discussions. We don't set up particular meetings but we do discuss things and problems that are coming up*, so *we all tend to know what is going on in our department*". This open approach, with informal conversations among the industrial engineering team is an ideal environment for the development of a second order approach. The interviewee's final remark on the subject, "*when things you develop make things better and you see the results of what you have developed making people's job life easier, that makes you happy*", reflects the people based philosophy of this individual and the industrial engineering department. The interviewee does have a feeling that he is personally responsible if improvement activities do not develop the solution required. Commenting on this he remarked, "*What makes me unhappy is when the solutions I develop don't work.*" Elaborating on this point, he went on to say that, this was a stressful situation and that he did have a sense that he was held personally responsible by others if a solution failed to function as expected. Comments such as, "*You are responsible, if something fails because of what you have done, you are responsible*" indicated this feeling of responsibility. While remarks like, "*You are only remembered for your failures*" and "*Everything you do that performs as it should is forgotten, it is the failures that you are remembered for.*" Indicate the opinion, that others hold him responsible for failures but forget successes. This could possibly be detrimental to second order; still, an overriding positive attitude prevails.

The theme of process and systems highlighted heavy workload that influencing organisational improvement activities. This was borne out in the following statement, *"Most of the problems in the factory are around production and getting the numbers out of the door"*. In discussing process problem solving, the interviewee outlines an opinion that a clear understanding of some process and problems is lacking. Additionally he points out, problems seem to appear and disappear for no apparent reason. The following passage from the interview outlines these opinions.

"Problems tend to go in cycles, you get nothing happening for a while, and everything goes wonderfully well. Then for no apparent reason, everything fails and does not work. You cannot find the reasons for that, we have looked, quality has looked and everything is inspected but we still cannot find the reason why it suddenly stopped working. Therefore, everybody puts a lot of time and effort into trying to correct the problem, when suddenly it rectifies itself. You are only half way through the investigation when it suddenly goes right again and everything is normal again. So you tend not to finish the investigation, because you do not find anything that is permanent and secondly you are more interested in getting back to what is important on a daily basis. The problem is this type of problem keeps coming back". The above passage indicates the type of problem that would benefit from a second order approach, where the first priority was the development of an understanding by all the improvement team of the system under investigation, its boundaries and possible associated potential problems. As the interviewee made clear, investigations into the operation of system' problems are often completed prior to the understanding of the functioning of the system, or the nature of the problem becoming clear. This, as mentioned, has the effect of problems reoccurring as no corrective or improvement action actually takes place. The comment, *"So you get to the point where you are going to spend more and more effort to solve a problem that is not a problem anymore, or are you going to move on to do something else. I wonder sometimes whether that's why we have these*

repetitive failures, is it because we never actually solve it; we carry on and it gets better so we stop looking for the cause of the problem" makes this point within the interview.

When discussing relationships, the interview brought out two important themes. Firstly, the reoccurring opinion that people work well together in their respective departments with the emphasis on the term 'departments', meaning the Industrial Engineering department. The statement *"As a department we get along together, we talk amongst ourselves help with each others problems that sort of thing"*. Shows the departmental thinking often found within the questionnaires and interviews. The second of the important issues raised was the relationships between managers and staff. Pointing out that generally, but not in all cases, managers have realised that a dictatorial style is no longer acceptable in today's climate with the comment, "*People now realise, they cannot be a dictator in their management style, you need to tread a fine line. I would rather work for a manager that treats me like a human being as opposed to a robot that sits on a line putting things together all day"* brings out this most important relationship points.

On communication, the type and amount of information gathered was this interviewees concern. "*The trouble is your operators spend so much time recording information, it has to be couched in certain ways, so they do not spend too much time but record the pertinent facts."* typifies this concern. On the overall subject of interdepartmental communication within the plant, his opinion was that communication is an area that is capable of considerable improvement. On this point he said, *"Over the last few years people have said that there is no communication within the factory, we have not improved it. Communication is a thing we need; if nothing else, it spreads the stress. Yes communication is a good place to start improvements"*.

3.2.2.7 Interview 007

The seventh interviewee was with the second of the two selected industrial engineers. This engineer worked in a different area within the manufacturing department. However, in common with all other industrial engineers, requests to assist in other areas are common, especially when specific expertise possessed by an individual is required.

In common with the other industrial engineer interviewed, he expressed what gave him job satisfaction in terms of solutions and achieving what he wanted to achieve. *"The days when you actually come in and feel that you have achieved something, when you see a job through to its conclusion"* were the words he used.

On the other hand, when speaking of the things that make him dissatisfied he, like most of the other interviewees, cited workload as a major contributing factor. On workloads in general he said, "*I think some of the targets are unrealistic, bearing in mind some of the things that can happen"* For this engineer, producing and testing of developmental products was his primary concern. This was expressed in the following manner, "*Pre-production is very stressful, we just cannot deal with it properly and everything has to go through as production. You would like time to go through each stage individually. Things have to go on a production schedule, so people want them as quickly as possible to make their targets. Instead of being allowed to spend the time needed, to go through this and to do that to make sure things are working, as they should".* This view of the product development process, indicates the inappropriate nature of combining development work into scheduled production. The interviewee continues with the discussion by saying that in his opinion, "*You only have a limited time available and you feel you are being pulled in two directions".* One conclusion that arises from the combination of the two industrial engineers interviews is the question; 'Is the poor development process outlined in this

interview a contributing factor in the recovering production problems outlined in the previous interview?'

The individual returned to the theme of communication being an area of importance and one that is in need of improvement. Commenting on written communication the individual gave the opinion that the language used was at best ambiguous and generally not understood by everyone. With regard to the standard operation sheets used in the manufacturing areas he comments, "*Some of the terminology that gets used is not very good. One person will have a particular way of writing things in a format, or way of words that everyone understands. Others may put words down as they speak them that are not easily understood. We need a common language, that is something we are looking for now, Industrial engineering quality and the flow line supervision are looking at the standard operation sheets at present.*"

The opinion expressed on team working and relationships, was in some instances people were 'seconded' onto teams just to make up numbers. "*We seem to be in meetings quite a lot. I have looked and I am in meetings every day this week. You just are sucked into another one by and large some times you think I am just here to make up the numbers*" were some of his comments on this subject.

While this interview as expected, concentrates on areas of concern to the individual, it as do others, still gives an impression of how the individual see the environment of the company in general. Like all other interviewees, this engineer displays the requirement of wanting to participate in improving not only production statistics but also the wellbeing of the people involved.

3.2.2.8 Interview 008

The eighth and final interview in the series was with one of the two company training officers. Responsible for all internal company specific training with the exception of safety, the training officers, also act as the contacts with external training suppliers. This interviewee had been with the organisation for ten years at the time of the interview.

Moving from engineering machine shop supervision, to the role of training officer some three years before the time of the interview his reply to the question what do you like about work was, "*Something new, most days a sense of achievement and this last three years I have had to learn a totally new career. It has brought up things and lead me into things that I did not know were there and I am really enjoying it*". He then went on to explain, it was not his idea but that of the operations manager to move him into his present role. He cited the need for people skills and his ability to work closely with others.

When asked what makes him unhappy, he mentioned workload and people not giving training the importance he thought it should be given. He was also in agreement with the comments from interviewee one, that a lack of company strategy and the attitude of some managers towards others was an issue. Commenting on his workload, he made the statement that "*the only thing that would make me unhappy at the end of the day is if I could not get finished what I need to get finished*". However, this statement is somewhat misleading. He carries on the conversation with the following comments, "*I have a major problem with people who enrol on a particular training course or particular staff development programs. We give them the dates that each of the particular sessions take place. We find they don't turn up for various reasons such as, I had to go somewhere else, I had a holiday that day, I have to go to Germany*". In his opinion, this is an indication that a number of individuals consider training unimportant. While he points out that many people really appreciate the training, a point corroborated from the questionnaire replies,

he comments, "*Supervisors and managers see it as a drain on their resources*". Interviews with the supervisor and team leader have both considered staffing levels being something of a problem; this statement about training draining the labour available for production is not surprising. Nevertheless, the interviewee does make one very important point about people and improvement, stating people thought the organisation should, "*understand the importance of training. If we do not train our people, we will not improve, if we do not improve we can-not be innovative, then we start to lose our share of the world market*". As the interview concludes on this issue, if we are not able to train people we will reach a stage where we are not be able to compete in the market place.

On the theme of teamwork, this individual highlights the difference between, giving a group of people an instruction of how they are to solve a problem, as opposed to giving them the challenge of providing a solution to a problem. Pointing out that the former, used frequently within the organisation, is not teamwork but an instruction forced on a group of people. His second point on this theme is one of volunteers, making the point that people should not be compelled to participate. He makes this point in the following quote "*You should pick out a dozen people; perhaps you would not need a dozen people on your team, bring them together and say, I have a problem who would like to help? Not I have a problem and you are going to be on my team, you are going to work on the job and the operations manager says you have to, which is what normally happens. You want it to be a way of bringing a bunch of people together, a dozen or so. You might not intend to have a dozen people on the team, you might want three or four or five or six. You can bring them together and give them the option in a way that it is a challenge for them to come in and help voluntarily*". This is an extremely important point when considering a second order improvement approach. In concluding his remarks on teamwork, he makes the observation that in some instances personalities within the organisation act in a counterproductive manner. He makes this point clear with the remark, "*if you were to get*

into a situation where you were working alongside one certain person for example, people then may be afraid to try to improve themselves because you have got some one who is continuously knocking you".

As with the other interviews, the overriding tone was optimistic. This interviewee did express some concerns with regard to the long-term strategy of the organisation. This concern was central to what he felt was a growing unease within the company with regard to what he sees as threats from overseas sister companies and competitors. However, he concludes that the organisation is highly competitive and extremely successful.

3.3 INTERVIEW FINDINGS

The sections above bring out the main points of interest and concern to the individuals with whom the interviews were conducted. This vertical analysis shows each interview considers the four themes emanating from the questionnaire analysis as important issues. However, the importance each individual gave to the themes varied in accordance to their role within the organisation. For example, the training officer considered training, communication and the development of individuals and teams to be highly important, while production supervisors were far more interested in meeting output targets. This example demonstrates, at times individuals do have conflicting opinions and interests. Additionally as the interviews with the industrial engineers show, the conflict between production requirement and improvement activities exist within individual roles. The horizontal interview analysis examined each interview transcript to gain further understanding of the emerged themes. As with the questionnaires, the understandings from the interviews of the four individual themes are discussed below.

3.3.1 Processes and systems

The interviewees used the terms processes and systems interchangeably. Meaning the processes and systems of manufacture and assembly and the methods used to provide

information and instruction. The interviews brought out the implication that all of the systems within the organisation were capable of being improved. This point was expressed most strongly during interview one, when the interviewee concluded that when he examined the systems within his department all had problems. Other points emanating from the interviews concerning this theme were the shortfalls of the development systems encountered during product development and improvement, along with improvement work clashing with production requirements. A point common to all the interviews is the willingness of all the individuals to work with and around the various systems to produce the required results. However, this willingness is tempered with frustration expressed by all the interviewees. This frustration is with the need to focus almost exclusively on the requirements of production, at the expense of improvement and training. The process and system comments from the interviews, question the adequacy of the systems and processes with the opinion that targets are met through the efforts of individuals, not the effectiveness of the processes and systems. While the questionnaires expressed concern on processes and systems, the interviews deepened the understanding that the emphasis put on achieving production targets at all cost seriously hinders the possibilities of system improvement. Additionally, the process for implementing new product production methods as part of the general production schedule leads to several system problems. These problems include the requirement to achieve targets, whilst at the same time attempting to prove the viability of new products and production process. The lack of opportunity to understand and optimise new processes, prior to their introduction to daily production as described in interview seven. Inevitably leads to the possibility that processes remain little understood and not at an optimum level of functionality. This possibly explaining the recurring problems discussed in interview six. A situation confirming the belief held by the interviewees, that process improvement is of low priority despite being a stated goal of the organisation.

3.3.2 Communication Issues

The message emanating from the interviews was that communication was an issue that required addressing. However, the consensus of agreement was not that there was a lack of communication. On the contrary, the interviewees voiced most clearly, there was an over-abundance of information, communicated in a multitude of formats. This sentiment put forward as a general comment within the questionnaires several times, has been the subject of discussion in greater depth within the interviews. Exploring this issue exposed several opinions regarding the quality aspects of communication within the organisation. These issues resolved around the subject of the quantity of information being generated for interviewee one. In this case, his opinion was, people were totally inundated with information emanating from meetings; start of shift meetings, end of shift meetings, daily production meetings, weekly team briefing, monthly process update meetings, as well as emails and reports of numerous descriptions. Compounding the issues of overproduction was the opinion; the information delivered from the various meetings was at times contradictory. So it became clear, communication is an important factor in the implementation of a cooperative improvement system. Individuals, groups and departments, require a common language to be able to discuss and understand others' ideas, opinions, concepts and beliefs. This was a point made by interviewee seven when discussing standard operation sheets. His comments regarding the attempts to generate a common language for use within operation sheets brings this point into the arena of second order understanding.

The message from the interviews was that communication was a second order issue, although not termed as such. Interviewee six made this clear when he stated, "*communication should be the first area to come under scrutiny when deciding what would benefit most from attention*". The interviews confirmed this general opinion from the questionnaires. This opinion, highlighted in specific areas such as standard operation

sheets, the questionable accuracy and general quality of information supplied, was an issue of concern for the interviewees.

The interview analysis indicates, while there is a wealth of communication within the company, the quality of the information communicated with regard to ease of understanding, content and applicability, is the main communication issue. Communication is an area of dissatisfaction, not only within this research, but also within employee surveys held over the past years. The emerging message is that the communicated information is in a number of instances, incorrect and in others irrelevant to the majority of individuals.

3.3.3 Relationships and team working

With very few exceptions, when asked about working with others the response received was positive. Most comments highlighting the fact, working with others was one of the most enjoyable aspects of working life. From the quotes shown above on this subject, it become obvious that not all believe an environment of trust exists, however, the majority holds this opinion. Nonetheless, the situation emerging from the interviews especially six and seven is that within small communities who have built up a relationship with each other, trust and cooperation exists. In the case of the industrial engineering department and the individual assembly areas, interviews from these departments, have all made specific reference to the trusting relationships being paramount for them to perform their duties. Therefore, the analysis confirms the existence of a mainly trusting environment; however, some degree of distrust does exist. This theme and the existence of a trusting environment underlie and make possible use of the 'second order' organisational model that is the central concern of this thesis.

3.3.4 Work variation and load

Workload was the most prevalent cause of dissatisfaction on a daily basis, being mentioned in each interview. During the analysis, it quickly became evident that the concern in this instance was the expected high production targets. Compounding this issue, is the apparent lack of target adjustment to take account of circumstances, such as operators on training courses, individuals on holiday, or any other reason that causes manning levels to be below requirements. This has been the underlying cause of several comments from supervisory and training personnel. Ranging from supervisors having to leave their role to work in the capacity of an operator in order to maintain expected production targets. To training officers, remarking on individuals not being available to attend scheduled training for the same reason. This issue affects the viability of a team working approach to organisational improvement. As interview eight with the training officer indicated, meeting production targets takes precedence over all other organisational activities. However, manning levels were at the point where it was difficult to release individuals from production to be able to take part in any training. If a similar situation arose with regard to improvement teams, it would become extremely difficult to maintain interest within the team on the improvement development, implementation and verification process.

3.4 SUMMARY

The first objective of this chapter was to verify the empirically based assumption that the social environment of trust and sharing of ideas exists within the organisation. The second purpose of the research was to emerge a set of themes thought important by the members of the organisation.

The analysis has highlighted that a trusting environment exists within groups working closely together. This situation is evident in both the questionnaire replies and interview comments. However, the analysis also shows that a level of mistrust exists on the part of

operational staff towards management. As interviewee eight maintains, a small number of managerial staff employ styles that generates mistrusts, stifling the willingness of individuals to share ideas. This is as a typical situation within any organisation, total trust, like total understanding, within a company is an idyllic environment, rarely if ever found and one that would be the ideal social context for second order understanding. Socially the analysis of the responses to the questionnaires and interviews indicates people within the company find work with their colleagues a pleasant and enjoyable experience.

The second objective of the primary research was the development of a set of themes thought of as important by the workforce. These were systems, interpersonal relationships, communications and the effects of workload.

Thus, combination of the two chapter objectives, give direction and an indication of the bodies of knowledge requiring investigation within the following literature review.

4 CHAPTER: 4 THEORETICAL PERSPECTIVES: LITERATURE REVIEW

The purposes of the theoretical perspectives are to build on the emergent themes identified in the previous chapter. The theoretical perspectives, take an interpretive examination of the bodies of knowledge as they relate to organisational improvement. While, understanding, working with others, communication, and system process have emerged from the initial research. The manner, in which these perspectives interact, is also of importance to the underlying organisational improvement direction of the research.

In looking to make improvements to an organisation, we must consider several factors. Primarily, we must have an understanding of the situation under review, along with the expected outcomes and benefits of the improvement. However, this in itself brings difficulties. The expectations of one individual or department are not always consistent with another individual or department. In coming to an understanding of the task or problem, we must first begin examining own personal understanding of the situation along with the aims and goals. Once we have a self-understanding, we can begin to explore the understanding of others', subsequently coming to a joint understanding of the situation and requirements. This is second order understanding as defined by Krippendorff (1993, 1995, 1996 and 1997). This is the first theoretical area examined.

Understanding others requires two-way communication and relationships. If we are to share ideas, thoughts, feelings and theories, we must have at least one means of communication. How we relate to others, has a profound effect on our ability to communicate and share understandings. Therefore, interpersonal relationships and communication as defined by (Buber, 1981; Krippendorff, 1996; Bohm, 2000) and others become a second theoretical perspective reviewed.

Having gained understanding of the aims of the improvement and come to an agreement with others, we will inevitably begin to define the extent of the affected areas. Thus, we enter the world of systems and system thinking, where it is practically impossible to implement change without identifying the system or systems affected by that change. Forrester points this out clearly in the following quote,

> *"Everyone speaks of systems: computer systems, air traffic control systems, economic systems, and social systems. However, few realise how pervasive are systems, how imbedded in systems we are in everything we do, and how influential are systems in creating most of the puzzling difficulties that confront us". (Forrester, 1991)*

Therefore, the theoretical perspectives concentrate on the emergent themes and the literature in those areas. Firstly, organisational improvement requires change to one or more systems. Secondly, we must have a method of communication to both identify the system under review and the goals of the change. Finally, to enact change we must agree what change is required, how that change is to be implemented and by whom.

4.1 SECOND ORDER UNDERSTANDING

4.1.1 Second Order Understanding: The Underlying Theme

The underlying theme of a 'second order understanding' approach to organisational improvement is the constructionist belief that as human beings we are individually unique (Resnik, 1996). Our uniqueness emerges from our experiences of life, which shapes our view of the world we inhabit (Depraz, Varela & Vermersch, 2003; Crotty, 1998).

As we journey through life, we experience the rich and varied phenomena of everyday living. The experiences we have of the world around us, the interactions we make and witness others are making, are the forces that form our opinions, prejudices and beliefs, from which our view of the world emerges (Maturana & Varela, 1980). Parents, teachers, friends and colleagues, along with the society in which we live, influence our beliefs.

From birth and as young children, our view of the world is limited to our immediate surroundings and family. As we grow and learn, our view of the world becomes more complex, enriching and expanding the mental models of the world around us (Piaget, 1955). Our experiences and beliefs bring forth our world, emerging our view of reality from 'within ourselves' (Smith, 2003). We fit the events we witness into our own personal reality, amend our view of reality to explain events, refining, enlarging and enforcing our worldview as we build understanding from our experiences. We all have a unique set of experiences that forms our view. No two people however similar will have an identical set of experiences. Therefore, no two individuals will have an identical view of reality. An individual's personal view of reality may be similar to that of many others, but it will never be identical.

We share many commonalities, especially with others from the same social and cultural background. However, no two individuals will hold identical worldviews. Identical realities require identical experiences and no two people could possibly have identical experiences. Worldviews may seem identical yet there will always be differences, small different perhaps but different nevertheless. Additionally, the view we create in our mind is incomplete; after all, it is our interpretation from an extremely limited exposure to the world. At any point in time and space, an individual occupies a unique position; no other individual can view the event from the same position or have exactly the same view. What is more, while an individual experiences one event, countless others are taking place that the individual cannot experience. In truth, we cannot see what others see, we can only develop an understanding of the way others see events, and why they see reality in the way they do. Even in coming to an understanding of others, we are interpreting their understanding in our terms not theirs. Understanding emerges from experience; we have no other way of building knowledge (Krippendorff, 1993). Under everyday normal circumstances, this incomplete, individually unique interpretation of reality is the

understanding of the world we accept without question. It constitutes 'first order understanding' (Krippendorff, 1997). In 'second order understanding', we interpret reality from our experience realising that it is only our interpretation. While at the same time, accepting others will interpret the same events from their experience and draw their own conclusion. This view is upheld by Colburn (2007) in his work with students on educational theory. Umpleby (2006), in his work on epistemology, examines this point of view in some depth concluding, reality cannot be known with certainty; it will always be an interpretation by the individual.

If we want to gain as complete an understanding of others' understanding as possible, we must first understand the way we understand ourselves. We must look deeper than simply accepting our own views without question and explore our underlying beliefs, we must ask ourselves why we hold the views we do. Krippendorff (1996, 1997) defines second-order understanding as, "*understanding of others' understanding including self understanding*". He maintains that second-order understanding arises in language, developing through dialogue. We must become interactively involved with those we wish to understand. Second-order understanding has dimensions, not reached using first order alone.

> *"'second-order understanding' is a way of knowing wholly different from ordinary (first order) understanding of things". (Krippendorff, 1995)*

Second order understanding has three fundamental requirements. The first is the recognition of others views being independently different from our own. The second is the relationship with others and acceptance of the 'otherness' of people. Here the term otherness relates to Bakhtin's interpretation of 'otherness' within a dialogism.

> *In what way would it enrich the event if I merged with the other, and instead of two, there would be now only one? In addition, what would I myself gain by the other's merging with me? If he did, he would see and know no more than what I see and know myself; Let him rather remain outside of me, for in that position he can see and know what I myself do not see and do not know from my own place, and he can essentially enrich the event of my own life. (Bakhtin, 1990)*

Bakhtin rejects the idea of a shared understanding being a goal of communication; stressing the importance of difference in developing a wider understanding of life. 'Otherness' does not constitute a common appreciation of an event, but rather a community of different, often conflicting interpretations. This has in many cases misguided and misdirected presuppositions (Cheyne & Donato, 1999). The third requirement is the communication of the differences between views. Relationships, recognition of otherness and communication in a dialogistic milieu are the essentials of a second order approach (Krippendorff, 1996).

4.1.2 Cognition

The Encarta English Dictionary (2007) defines 'cognition' as, "*the ability to acquire knowledge*". With 'knowledge' defined as, "*the general awareness of information, facts, ideas, truths or principles*". However, the term cognition is used in many contexts; for example, LaBerge (2006) uses it in relation to the neurological functioning of the brain, while Toates (2006) uses the term when discussing the subconscious and conscious processing of information by an individual. Cognition is a term used in wildly different ways by different disciplines. Wider interpretations of the meaning of cognition associate it with the development of ideas, concepts, and mind maps of the world. For the purposes of this research, cognition is the inner reflective leading to the development of underlying beliefs and opinions, which form an individual's knowledge. Piaget (1955) provides a prime example of the cognitive process developing the awareness of information, ideas and opinions that constitute knowledge of the world.

On the day of our birth, we have no preconceptions or beliefs, we have no verbal language, and we are creatures of instinct and evolutionary pre-programmed responses. Our worldview is a blank canvas awaiting attention from the artist of life's experiences. The

artist within ourselves that constructs a mind mapped picture, of how the world operates for each of us. Piaget (1955) in his "Theory of Cognitive Development" defines four cognitive phase, or ways of relating to the world that individuals pass through as cognitive abilities develop and mature with age. The four phases begin with infancy, when it is only possible to experience the world through movement and the elementary senses. In the preschool phase, motor skills develop allowing wider independent exploration. In childhood, logical thinking about experienced events develops. Finally, from adolescence onwards, abstract reasoning emerges allowing reflection on ideas unrelated to personal experience. Within each phase, we use more in depth analytical mental processes to develop our conceptions and views. Each has its particular domain of knowledge and method of interpretation. As the method of interpretation changes, then so do the number of possible reactions to events encountered. This work has been recently supplemented by Zigmond (2008), with his work on encouraging students to ask questions and contribute to discussions. His observations and conclusions' are directly transferable to improvement teams.

As we move through the cognitive phases, we have many influences shaping and developing our opinions. We develop the language and terminology of our social surroundings. What other alternative do we have? We accept the worldview given to us without question. We hold what Krippendorff (1995) terms '*a first order understanding of the world*'. As we grow and progress through each developmental phase, we encounter a wider ever increasing range of individuals who influence us: teachers, friends, work colleagues. These and more all have an input to our knowledge of the world, influencing our perceptions and opinions. This constitutes the society we live and work in. However typical or similar an individual's worldview may be with others within the surrounding society and social network, it nevertheless remains unique. As we have more experiences, we have more opportunities to learn from and communicate with others, developing

knowledge in the process. Reality emerges from within, built on the personal interpretation of the experiences with reference to our view of how the world works. This concept has been termed, the Constructionist Learning Theory by Piaget (1955). He maintains that individuals use 'accommodation and assimilation' to construct knowledge from experiences. Assimilation occurs when an experience is capable of explanation using our existing knowledge. In this case, the experience enforces our existing beliefs. Other experiences are incapable of assimilation. In these instances, we rethink and reconstruct our opinions and assumptions. In order to explain and accommodate the new experience into our knowledge of the world we must update our worldview. Without conscious thought, we construct knowledge, test it against reality, modifying and rebuilding our worldview as our experiences increase. However, this is first order understanding, second order requires us to ask why we see the world as we do. Second order can only develop when we take a step back and examine our interpretations through the lens of personal enquiry.

In 1973, the two Chilean biologists Umberto Maturana and Francisco Varela introduced the concept of autopoiesis, literally meaning from the Greek auto (self) and poiesis (creation or production). Therefore, an autopoietic system is one that reproduces itself, in essence a system that has itself as one of its outputs. Maturana and Varela define autopoiesis through a description of a living machine.

> *"An autopoietic machine is a machine organised (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realisation as such a network" (Maturana and Varela, 1980).*

This is an abstract cybernetic description; however, put simply an autopoietic system is one that through its operation maintains itself. If considered in terms of the human body, it is a

biological system, continually regenerates itself at the cellular level. In essence, internal processes reproduce the components that make up the human biological system. Organisations also have systems that continuously regenerate themselves; people are replaced when they leave, and through the review process, procedures are improved. An organisation reshapes and reinvents itself to maintain its existence.

Autopoiesis is a creative exploration of the concepts of complexity, self-organisation and emergence. In relation to second order understanding, the theory aligns itself with the argument that each individual envisages and reacts to the world in ways they are able to recreate.

Maturana & Varela (1980) consider cognitive actions as functions of embodied experience. Autopoietic theory maintains, cognition is a consequence of circularity and complexity within an autopoietic system. The development of knowledge allows us to interact with the world; however, we can only interact in the manner we are capable of interacting. We do not process what is objectively there, but what we interpret to be there. We often see what we want or expect to see, not what is actually there. We can only see what we are capable of seeing; we are blind to everything else (Maturana & Varela, 1988)

> *"Living systems are cognitive systems, and living as a process is a process of cognition". (Maturana & Varela, 1980)*

Living and cognition form a self-perpetuating feedback loop, the process of living develops our level of knowledge. While the ability to acquire knowledge with reasoning and perception allows us to interact with events and carry on the process of living. We use the experiences we encounter to develop our understanding of the world we live in. While simultaneously, amending our worldview from the knowledge gained, enabling interaction in more varied and productive ways. Maturana and Varela's (1980) autopoietic cognitive process of living, combines with Piaget's (1955) learning theory, delivering the message,

human beings develop understanding of the world through their experiences. Subsequently using, the knowledge gained to redefine their mental models. As an individual's reality changes, he or she enables reactions to events from within themselves not previously possible, they begin to see things they just could not see previously.

> *"A cognitive system is a system whose organisation defines a domain of interactions in which it can act with relevance to the maintenance of itself, and the process of cognition is the actual (inductive) acting or behaving in this domain". (Maturana & Varela, 1980)*

As humans, we find ourselves in a privileged position with respect to cognition and knowledge. Unlike other autopoietic systems, we not only interact with our environment, we deliberately alter the environment to suit our needs. Cognition allows us as scientists and engineers to shape our physical and social surroundings in ways and with effects not possible to other living systems. Throughout human history, individuals have joined in groups with a common cause to perform jointly agreed actions a single individual would not be able to carry out. As groups of like-minded individuals, humans create artificial domains such as, manufacturing organisations, governments', social structures, towns and cities. However, while working towards a common goal, individuals will retain their own perspectives and opinion as to the desirability of the agreed goal.

As observers, we all come to any observation with our own set of beliefs. (Maturana & Varela, 1980, 1988; Piaget, 1955; Senge, 1990; Krippendorff, 1996; Umpleby, 2004), and (Umpleby & Dent, 1999) are sending the message, we are not detached from our surroundings; we are a part of them. It is not possible to stand outside an observation, the fact the observer is present has an effect on the situation. We interact with the people and phenomenon around us in the ways possible as autopoietic theory maintains (Maturana & Varela, 1988). Cognition is a human phenomena, it is knowledge acquired from and shared with other human beings (Cash, 1998). Cognition is the ability to find one's way around one's beliefs, assumptions and opinions that constitute personal and shared cultural

knowledge; it allows appropriate selections of reactions to the circumstances encountered (Hodson, 2002).

4.1.3 Relationships and Otherness

To understand others, we must first understand ourselves; it can only be through self-understanding and the realisation of personal prejudices affecting our worldview. Only then, can the understanding of others' understandings begin to develop. We need to see the 'otherness' of people, the reflection of the humanity, the strengths, weaknesses, hopes and dreams that each member of the human race possess.

Martin Buber (1958) developed a theory of relationships, that introduces 'I-It', and 'I-Thou' classifications. For Buber the 'I-It' and 'I-Thou' relationships formed the basis of self-understanding and subsequently the understanding of others. He establishes the need to distinguish between types of relationships and the interactions differing relationships allow. Arguing that if we distinguish the different relationships we have with others, we are then able to understand the interactions possible. For example in the 'I-It', relationship, the other is perceived as an object. Thus, we can only interact with them as inanimate and non-responsive entities. While in an 'I-Thou' relationship, we relate to others as thinking responsive individuals, who have thoughts and opinions of their own that are worth considering.

Buber (1958), Krippendorff (1996) and Cockburn (2000), argue that it is possible to regard other human beings as mere objects, automatons without feeling. Buber terms this the 'I-It' relationship. A relationship that is devoid of feeling: that treats people simply as objects that will react in repetitive and predictable ways. We learn very little from such relationships, we see what we expect to see: hear what we expect to hear. We experience the other person as an 'It', a thing, not as a fellow human being. Such experiences are

wholly in the terms of the 'I', the 'It' has no interactive abilities, there is no connection or mutual understanding, and can never be anything other than a one sided 'first order' 'unidirectional' one way relationship.

'I-Thou' on the other hand is a second order two-way bidirectional relationship: deeper and more rewarding to the individuals involved. Such relationships embrace the otherness found within people. The second order aspect of the 'I-Thou' relationship encompasses the differences between individuals, allowing mutual interaction. 'I-Thou' builds through exploration of the internal self of 'I' and the external self of 'Thou'. This relationship looks out into the world; it is simultaneously internal and external to the observer, putting the observed and observer in the same domain, the 'I' joins with the 'Thou' in a reciprocal recursive interaction. Second order understanding, impossible in the 'I-It' becomes possible, when 'I-Thou' relationships develop.

For Buber the ultimate relationship is the eternal 'I-Thou'. For him it is a religious experience, the ultimate bonding with a supreme being, joining with whatever an individual sees as his or her God. This is an 'I-Thou' relationship that can never degenerate as is possible with other 'I-Thou' relationships, hence the eternal title. 'I-Thou' by its very nature is truly open and trusting, a relationship of mutual caring and respect. In interpersonal terms, it is a continuing caring considerate relationship between people, one of unselfishness and mutual respect. We reach a new level of awareness when we develop 'I-Thou' relationship with others. The relationship changes our internal self-awareness and the external awareness of others around us. 'I-Thou' forces us to consider others as interactive beings with thoughts, dreams, aspirations, ideas and opinions that are as relevant as our own.

Buber notes three ways in which we can become aware of the 'Thou', beginning with the bare minimum awareness of others. Buber contends the minimum awareness relationship is possible with animals such as a pet; however, we can never be sure if the animal experiences ourselves as a 'Thou' (Buber, 1981). We attempt to communicate in ways we would never do with a mere object in an 'I-It' relationship even with animals. Buber's second form of 'I-Thou' is the most common. We experience others as complete human beings and are aware of them as another 'Thou'. When we engage the other person in conversation, we expect and receive a response, establishing the 'I-Thou' relationship that can only be fully realised in conversations. The third and final form of 'I-Thou' is the eternal, spiritual mystical relationship. Buber maintains this is a clouded relationship disclosing itself not in speech but belief. In the end, we cannot speak of the eternal 'Thou', of which we may not be aware, yet is undeniably there (Buber, 1981).

Buber's original thoughts on 'I-It' and 'I-Thou' leads to the interpretation that his is a one to one 'I-Thou' relationship. For Buber the ultimate 'I-Thou' relationship, the eternal Thou as he terms it, is extremely personal (Friedman, 2002). While underpinning important basic relationship principles in second order understanding, his interpretation carries a personal religious connotation that on first examination may be unsuitable for organisational application. 'I-It' and 'I-Thou' in Buber terms required refining to meet the needs of understanding in today's second order organisational improvement contexts.

Krippendorff (1996) develops and expands Buber's two 'I-It' and 'I-Thou' distinctions into four categories, 'I-They', 'I-It', 'I-You', and 'I-Thou'. This expansion and repositioning from the original interpretations, have a more significant meaning in today's second order improvement approaches The four relationships fall into first and second order understanding categories, 'I-They' and 'I-It' being 'first order', while 'I-You' and 'I-Thou' are 'second order'. These relationships are summarised in the following ways.

'I-They',

The 'I-They' relationship is one of statistical aggregates, classifying people into pre-defined category', assuming each member acts identically to all other members not as an individual.

> *"'I-They': statistical aggregates,*
> *They are the subjects in experiments, the interviewees in public opinion polls and the respondents to survey questionnaires. They are the others' we have nothing in common with". (Krippendorff, 1996)*

Observed by detached observers, the individuals constituting the 'They', or more appropriately, groups of faceless individuals, grouped together into whatever type the observer is referring to as the 'They' category. 'They' types are groups with attributed such as being male, female, students, of a given age, race or religion (Krippendorff, 1996, 1998). Whatever the attributes assigned, assessment is with standardised measures, allowing the formation of incontestable answers. Unable to speak for themselves the individuals referred to as 'They', have no opportunity to question the assumption or conclusions made by the unknown unseen 'I' observers. Statistically, the individuals classed as 'They' in 'I-They' relationships, are passive members of statistically arrived at groupings. They have no personalities just group characteristics.

'I-It'

The 'I-It' relationship sees people as machine like objects.

> *"'I-It': trivial & non-trivial machines (seeing people as machine like objects)*
> *We know how difficult it is to figure out what people are thinking and to predict what they will do, even in everyday situations. Interaction between sensation, memory and action is widely assumed and we feel comfortable constructing cognitive models on this assumption. (Krippendorff, 1996)*

As humans, we do not react in machine-like predictable repeatable ways. Humans have a richer set of reactions to the complexities encountered than those displayed by machines. The variety that people actually display overwhelms the detached observer position of the

'I-It' relationship. Using trivial or non-trivial machine relationship denies the humanity and richness of the individual. 'I-It' redefined by Krippendorff (1996, 1998) remains first order, focusing on action and reaction, totally ignoring the humanity within an interaction.

Both 'I-They' and 'I-It' are first order relationships. Second order requires a deeper understanding of individuals, a completely different way of thinking to the idea that people can be categorised and thought of in generalities of 'I-They' and 'I-It'.

'I-You'

'I-You' is people in communication.

This relationship is the beginning of second order understanding by the acceptance of another person's individuality, seeing them as another human being with beliefs of their own.

> *"'I-You': persons in communication*
>
> *'You' occurs in talk among people that are responsive to each Other. Neither the speakers nor the spoken to can escape knowing something of each other. 'I and You' denote persons. Communication between them becomes a collaborative effort and inquiries within I-You relations essentially are participatory. Conceptions of You and I are always complementary. Complimentarily must not be confused with equality, however. Nor does it have anything to do with sharing. It simply suggests that roles somehow fit like hand in glove (not like hand in hand) and the difference between them is constitutive of a particular relationship". (Krippendorff, 1996)*

An 'I-You' relationship always refers to people as individuals, recognising a dimension present but ignored in 'I-It'. 'I-You' occurs between individuals that are responsive to each other. It is conversation where the speaker and the listener know something of the other. Both individuals have some knowledge of the others opinion's and belief's. 'You' and 'I' are complimentary, a teacher and pupil, master and apprentice, departmental manager and staff member. The 'I-You', relationship is one that contains a hierarchical element. Respect and concern for the other person can be present but the relationship is not one of equals. This is a complimentary relationship, one in which individuals work

together harmoniously to attain agreed goals. However, it remains a hierarchical relationship, with one individual guiding the other.

'I-Thou'

'I-Thou': human beings in conversational dialogue.

The final of the four relationships, the 'I-Thou' relationship is truly second order; a dialogical relationship that does not impose beliefs or opinions onto others' but explores the difference between perceptions.

> *"'I-Thou': human beings in conversation*
>
> *I and Thou denotes a pair of complimentary constructions of people characterised by their ability to speak for themselves and to create a world of their own, recursively including therein the worlds of others. In I-Thou relations, people constitute themselves in conversational practices: neither unilaterally imposes its categories on the other. Neither assumes a position superior to the other. Neither claims to be the agent for a larger whole, the guardian of an overriding purpose, or the owner of a universal truth."*
> *(Krippendorff, 1996)*

In 'I-Thou' people are able to speak freely, sure in the knowledge that their opinions will be taken into consideration. People embrace the world of others; it is possible to question the assumptions beliefs and prejudices of those within the relationship. There is no goal stated by one person, only a willingness to explore a situation and allow a result to emerge from the exchange of thoughts and the investigation of various views. A feature of 'I-Thou' is that positions are freely interchangeable. 'I-Thou' relationships are self-embedded in the conversational dynamics of the individuals; emerging from dialogue, becoming local to the moment and the people involved and closed to outside intervention at that point in time. In 'I-Thou' relationships human beings are true to themselves (Gadamer, 1975), authentic (Roberts, 1985), intimate with each other, and responsible for and to each other. Buber (1958) speaks of 'grace and of 'love' in 'I-Thou' relationships. When approaching organisational improvement from a second order understanding perspective, the relationship required is minimally 'I-You', although 'I-Thou' is preferable and more appropriate (Krippendorff, 1998). The importance of 'I-Thou' to second order

lies in the recognition that individuals will have their own perception, a fact to take into account when considering what action to take that requires joint agreement.

Relationships develop as a group begins working together. Such relationships can be dictatorial with one person or a sub-section of the group taking a leading role. This could be classed as 'I-You': a manager giving instructions to a group of subordinates. Such relationships are not conducive to second order understanding joint agreement. When an individual feels compelled to take a certain line, he or she is unlikely to feel free to give an alternative perspective. In contrast, when a group listens to each other sharing thoughts and ideas, second order understanding can develop. The requirement is for each member of the group, to say to themselves, "Maybe I don't know best, maybe it is worth listening to alternative opinions". The truthful, authentic, intimate inter-responsible, grace and love aspects of 'I-Thou' (Gadamer, 1975), (Roberts, 1985), (Buber, 1958) allows the development of second order understanding.

4.1.4 Language and Communication

The understanding of relationships and human behaviour is through the use we make of language (Holquist, 2004). Communication is the foundation of what it means to be human. When a child utters its first word, it marks the beginning of a transformation towards human interaction (Spohn, 2007). Communication is the inseparable fusion of language and relationships, each affecting and in turn affected by the other. We communicate through language, build relationships through communication and in relationships develop language. We live in a world of communication, group meetings, emails, video conferences, telephone calls and many other communication methods. No matter what form is used, the purpose remains the same, which is for one individual to transfer his or her wishes, ideas and thoughts to other individuals.

Communication is the essence of what human beings do every day in their personal and professional lives. Although, often taken for granted, it is the ability to communicate that allows coordination and collaboration of actions (Church, 1996).

Despite its importance, mastering organisational communication is not easy, misunderstandings occur between individuals, changing meanings and interpretations. Effective communication is not a natural ability; it is a learned skill, requiring practice to reduce possible misinterpretation. The way we use language defines relationships, almost locking us into a particular method of interaction with another person. This has been examined by Downing (2008). His work had examined the methods used by managers within manufacturing to communicate with employees' in what he terms the communication risk. He concludes that the choice of language used can help or hinder the resulting relationship. Language enhances bidirectional understanding and transfer of meaning when used in a second order context, while ruling out understanding altogether when used in a first order relationship. Communication is at times unidirectional, travelling in one direction only, forming a first order 'I-It' relationship, considered as instructions or commands by the speaker. Unidirectional communication has no feedback; in fact, the 'I-It' relationship denies the possibility, with speakers expecting listeners to carry out the commands given without question. This form of communication, better described as instruction, creates a mental model of a simple activity used to achieve clearly defined objectives. People send messages in an 'I-It' relationship, attempting to control people like machines. However, people are not machines; people are thinking beings with minds of their own. The assumption, 'we are able to predict the outcome of instruction' is incorrect (Penman, 2000). Communication is an interpretation by one individual of a comment made by another; it is not simply an instruction clearly understood. This is the downfall of unidirectional first order communication, clarifying the meaning of the message is extremely difficult without feedback. This form of communication has no way of evaluating the message received by the listener. The listener reacts to the message in

line with their interpretation; this opens the door to misunderstanding or gap between subjective viewpoints (Craig, 1999). Unidirectional communication therefore is unsuitable when a second order approach to organisational improvement is required.

We must look on second order communication as a bidirectional activity. Second order understanding turns to dialogue as the method of communication. Dialogue as outlined by Bohm, Factor & Garrett, (1991), is a way of building understanding and trust among those taking part. Dialogue is not just 'talk'. It is the embrace of differing points of view; literally, it is the art of thinking together (Karagianis, 2001).

To understand 'dialogue' in second order understanding terms: an understanding of what dialogue is not becomes important. Dialogue is not discussion or debate. These forms of communication hold an implicit tendency to be adversarial and goal orientated when attempting to come to an agreement in trying to solve a problem (Bohm, Factor & Garrett, 1991). Discussion and debate tend to result in a consensus with one opinion winning out over others. However, this fails because increasing diversity and complexity requires collaboration with one another in order to survive. Forward thinking individuals realise that in order to maintain competitiveness, increase market share and create an overall 'just' organisational society, all kinds of groups need to come together to discuss the aspects that affect their future. The group is also aware of how we converse with one another is important. Dialogue is a focused conversation engaged into deliberately, with the aims of increasing understanding, addressing problems and exploring thoughts, perceptions and actions (Romney, 2003). It is an emergent activity coming from both the heart and the mind at the same time. Differing from casual conversation in that it has focus and a purpose. Unlike the adversarial nature of debate, dialogue centres on the interpersonal relationships as much as the topic. Ultimately, dialogue seeks to explore, presupposing a willingness to modify deeply held beliefs.

Dialogue does not seek for one opinion to prevail. Just the opposite, dialogue requires the opinion of each individual to be of equal importance, accepting all, ignoring none, in coming to an agreement. Considering dialogue as an informal gathering of people to chat and exchange pleasantries is an incorrect interpretation. Dialogue is a formal activity to examine specific issues (Bohm, 1990).

Dialogue most certainly requires a trust between individuals to allow free exchange of opinions. It is primarily a communication process enabling the examination and understanding of the varying views of the participants. The possibility of lasting organisational improvement increases in proportion to increased interpersonal understanding among participants. Dialogue in essence, is a means of exploring the presumptions and beliefs underlying the process of thought (Bohm, Factor & Garrett, 1991). Understanding becomes fundamentally social and language becomes part of everyday being in the world. The communication structures used need to be open to evolution in order to accommodate and promote new opportunities.

It is through language that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together (Church, 1996). Bohm (1987) suggests the requirement for a new type of dialogue in human communications. His basic idea is to be able 'to talk' while suspending opinions. We must perceive the meaning of everybody together, without having to make any decisions, or saying who is right or who is wrong. It is more important that we all see the same thing (Bohn, 2000).

'I-Thou' develops between people that enter into dialogue regularly. Trust develops that will carry over into discussions. Additionally, participants come to understand how a greater understanding emerges by suspending their own point of view. They learn to free themselves from their locked in prejudices and beliefs, opening their minds to new ways of viewing the world. Dialogue gives the opportunity to build on the idea that each of us has a unique perspective on a larger reality that none of us can see in its entirety (Deirdre & Baker 2007). If 'I' can examine and look through your view of reality and you through 'mine', then we both might see something we had not seen before (Senge, 1990). In this way, an organisation is able to take conversations and collective practices to a higher level. The form of dialogue suggested by Bohm (2000), encourages opening up and engaging in listening with the particular purpose of understanding. Listening for the sake of hearing what others' thoughts and opinions are, listening to what is being said, rather than what we want to hear; whilst trying consciously to overcome our assumptions and judgements. It is building awareness of what is 'heard', without focusing on it through the lenses of our judgements and assumptions. 'Listening' increases the chance of becoming sensitive and thus, able to hear the prejudices of agents outside ourselves. This form of dialogue is a core element within any human enterprise. Dialogue is about involvement, about co-creation of meaning. A creative dialogue process in organisations will enhance the capability of developing a meaningful language providing a valid venue for action, continuous learning and second order understanding.

Bakhtin's (1981) philosophy of dialogue has been termed dialogism (Holquist, 2000). The term has become associated with Bakhtin and his theory of knowledge that seeks to understand human behaviour through the use humans make of language. Within dialogism, 'otherness' describes a differential relationship between a centre and all that is not centre, a centre that is 'self or I' and a not centre that is 'other'. Holquist (2000) stresses that 'centre', 'I' and 'self', must not be assumed to hold any special privilege or

power, these are relative rather than absolute terms describing the observer. 'Self' is dialogue, in as much that internal voices enter into a silent dialogue; the self emerges from a multitude of voices, each with its own independent perspective, and these voices are in a dialogical relationship with each other (Barresi, 2002).

Hermans, Rijks, & Kempen (1993) state:

> *"Different voices, often of a markedly different character and representing a multiplicity of relatively independent worlds, interact to create a self-narrative"*

A self-relation is fundamental to dialogism, helping us understand how other human relationships work, recognising the 'otherness' that is not 'self', of things and people around us. Baktin describes the dialogic nature of self and other as the dialogical nature of consciousness. Life by its very nature is dialogical; we ask questions, listen to responses and come to agreements. In dialogue, people participate fully, inserting their entire self in discourse, entering into the dialogic fabric of life (Bakhtin, 1984). Dialogism argues that all meaning is relative (Zappen, 2000; Holquist, 2000), coming about because of the relationship between two bodies occupying similar but different space. Bodies can range from physical entities to ideas in general (ideologies). In Bakhtin's dialogism, the positioning of the observer who is an active participant within a relationship is fundamental, as it is in second order understanding. Thoughts and opinions explored within any dialogue emanate from those positions in space that each of the participants holds with regard to the event under investigation. Holquist (2000) terms this the Law of Placement and states:

> *"Everything is perceived from a unique position in existence; its corollary is that the meaning of whatever is observed is shaped by the place from which it is perceived". (Holquist, 2000)*

In essence, this law clarifies the fact that we all occupy unique positions within time and space. The statement reinforces the concept that experiences are from a particular position within the world. It then inevitably follows that the world comes to us from the position of

our unique 'I' or 'Self'. We each see the world from differing viewpoints, therefore the dialogical 'other' becomes part of the world of our 'I' and the otherness of ourselves, becomes part of the world of another individuals 'I' (Gould, 2007).
The perceiver 'self' and perceived 'other' cannot exist as separate entities. 'Self' and 'other' can only exist in a relationship. Bakhtin (1984) defines existence as an event that he terms the 'unique and unified event of being'.

When a dialogue takes place between two people, 'one self other relationship with another self other relationship', the medium of exchange is of course language. In language, words fix the meaning for those taking part, enabling the exchange of distinctions between differing perceptions, creating patterns of understanding in the mind. Words exist only to chronicle experiences into meaningful patterns. Language while confirming sameness has its main use in exploring difference. The units of existence we call 'self', has a most precious characteristic. The characteristic of being what 'others' are not, it is the difference that creates meaning. It is the function of 'selves' like words to provide a mechanism for differentiation. The purpose being to give order to what would otherwise be the chaos of lived experience. Dialogism exploits the nature of language to model the nature of existence. Dialogism sees language along with social and ethical values as the fundamental means of developing meaning and understanding. Dialogism argues that we make sense of existence, by defining our specific place within it. We perceive the world through the time/space of the self and of the other. The difference between the two is a relation of otherness, gauged by differing positions of the 'self and the other' (Holquist, 2000).

Language forms the dialogue with the 'self' and dissemination of differences with the 'other'. This is another way of stating the ethical maxim: treat 'yourself' like an 'other' and the 'other' like a 'self' (Peters, 1999). Bringing us back to the fundamental theme

running through dialogue, that of allowing the 'otherness' of other people to emerge, to listen and hear their voices.

As Bakhtin said:

> *"A word (or in general any sign) is inter-individual. Everything that is said, expressed, is located outside the soul of the speaker and does not belong only to him. The word cannot be assigned to a single speaker. The author (speaker) has his own inalienable right to the word, but the listener has his rights, and those whose voices are heard in the word before the author comes upon it also have their rights (after all, there are no words that belong to no one)". (Bakhtin, 1986)"*

When we speak, the words used belong to a communal language shared between the individuals taking part in the conversation. No one individual can claim ownership of the word, or the conversation. Bohm (2000, 1987), Bakhtin (1986, 1981) and Holquist (2000) are telling us that dialogue builds second order understanding through the use we make of language. Dialogue lays great emphasis on listening, if we do not let others speak, if we do not listen to what they have to say, we impoverish our own understanding. We return to the monologue of instruction and direction that typifies unidirectional communication. For a second order understanding approach to organisational improvement dialogue, and only dialogue, not debate allows the communication and exchange of ideas, opinions and assumptions in a way conducive to developing understanding. Social systems exist for their members. They are humankind made epistemological entities that allow the co-creation of reality. Where language agreements decide what is true and what is false. Meaning becomes fundamentally social and language becomes part of everyday being in the world, as Wittgenstein (1976) points out:

> *' Human agreements decide what is true and what is false? It is what human beings say that is true and false; and they agree in the language they use. That is not agreement in opinions but in form of life' (Wittgenstein, 1967).*

Language surely affects our perceptions of how we create a world and what becomes real to us. Without an awareness of language we are, as Heinz von Foerster (1979) noted, double blind: we do not see certain things that others could bring forth and we do not see

our not seeing. The cure for such blindness lies in consciously deviating from established linguistic practices, for example, by developing a new vocabulary, or introducing new metaphors.

4.1.5 Reflections on Second Order Understanding: The Three Legged Stool

When embarking on any improvement initiative, people naturally examine the situation to be improved. Data, the 'facts and figures' of the situation as seen by those conducting the investigation are gathered, analysis is undertaken and action plans made. However, in most cases using traditional first order approaches people 'factors' are given little if any considered. The people effects on a situation are considered insignificant and therefore to be ignored. The standard first order approach looks only at the stark facts of a situation, ignoring the human and social interactions that are present whenever two or more individuals work together (Umpleby & Dent, 1999).

Scientists and engineers for decades have taken the stand that as researchers and observers they should be detached from the situation under examination. Impartiality of investigation, analysis and presentation of findings is a requirement of this form of investigation. Nevertheless, as scientists and engineers are also human beings. No matter how hard they try, they are unable to divorce themselves from our deep-rooted presumptions, beliefs and prejudices. It is exactly these underlying presumptions, beliefs and prejudices that form the way we think about and perceive the world, making us the individuals we are (von Foerster, 1994). Understanding the problem and analysing the facts, is the approach of most problem solving processes. This is a first order subjective approach that suffers from the drawbacks previously outlined.

Although some disagree with the constructionist second order view, they are in the minority, with the mainstream of system thinking agreeing with the constructionist

standpoint. Masani (2001) for example termed 'constructionism' and therefore by implication second order understanding "*the modern enemy of science*". His view that constructivism totally rejects 'objective reality' is an extreme interpretation of the constructive view of the way humanity perceives reality.

Masani (2001) speaking of constructivism and thus second order, maintains that constructivism is 'anti scientific to the bone'. Asking what constructivism replaces science with, he concludes it to be a 'pseudo scientific edifice' based on child psychology that denies the scientific approach. He maintains that only a rigorous fact based scientific approach will reveal the one and only one true reality. Masani's criticism is as an extreme reaction to the constructionist viewpoint of what is true and false with the world is not a fixed objective reality but an agreement between people (Wittgenstein, 1967).

The stance taken with this research is, there is a place for first order approaches in factual based research, material qualities, chemical reactions, pharmaceutical development etc. However, when social reactions become a fundamental part of the research, as is the case with organisational improvement, a second order approach is more appropriate. Masani (2001) concludes with the proposition that "*The danger with the constructivists' doctrine is that it may lead to the belief that each individual is entitled to his own view of reality*". Ironically, that each individual will have his or her own view of reality is exactly what second order maintains. In fact, second order goes one-step further, with the proposition that, no two individuals can possibly possess an identical worldview and therefore all individuals undoubtedly will have their own view of reality. Second order is about understanding these various views. This research does not reject objective reality; the view taken is that the formation of reality for each of us is from our experiences of the world. The only way we can experience the world is through ourselves. However, while individuals may not understand some scientific principles, such as the law of gravity, we all understand and agree its effects in our everyday lives. When a glass of water held in an

outstretched hand is released, who would not expect it to fall to the ground? We may not be able to describe the law of gravity but we all agree the glass will fall. Likewise, two observers describing a set of dining chairs will use their personal knowledge in framing their description. For example, an antique dealer may describe them as an extremely rare example of a set of Chippendale dining chairs, characterised by the graceful flowing lines, cabriole legs, and elaborate ornamentation. While some one else may simply say they are dining chairs and a third just say they are chairs. However, all three would probably agree that a chair is something to sit on. It is from such general agreements that specific group agreement on events and the improvement actions required for a situation are developed, enacted and evaluated. Second order understanding, is important in development of such agreements via exploration and understanding of the differences in worldview.

Maturana & Varela (1987) argue that, the phenomenon of knowing, cannot be taken as though there were 'facts' or 'objects' out there that we grasp and store in our mind. The experience of anything is validated in a special way by the human structure. Facts, information and knowledge are not objective characteristics of the world; they arise in the interaction between the human observer as an autonomous system and the world. Our enactment of the world constitutes our knowledge, our reality. Thus, there are no identical cognitive realities; different observers perceive different realities. The understanding of some other person's 'understanding' is always a personal understanding of someone else's understanding of the world (Krippendorff, 1993), in other words second order understanding. This view does not reject the existence of objective reality. However, it strongly emphasises that, the reality we know is the reality of our experience.

In the late sixties and seventies writers such as (Churchman, 1970) and (von Foerster, 1979) began to question the assumptions of observers being able to be detached and impartial in their findings. Thus, second order thinking came into being. This does not

mean that 'second order' concepts are just fifty years old, only that the term second order is about fifty years old.

The basic difference between first and second order is people, their involvement and interaction within situations and events. Second order accepts, as observers we are not cold detached analytical machines. We are human beings, with all the faults opinions and prejudices that inevitably come as an indivisible package with each member of the human race. Second order moves the observer into the event, making him or her part of the unfolding event. The interactions of the people within the system under observation become as relevant as are the measurable facts used within first order. Social observations along with observable facts bring, contextual meaning and an understanding not possible using first order alone. Finally, second order seeks to understand the problem or situation not only from the point of view of the observer, but more importantly from the understanding of other people within the observed situation. Delving deeper into the motivations of the individuals, it looks to bring out underlying assumptions and beliefs that have an influence and cause interactions that affect ongoing events. The emphasis moves from fact to social interaction, not ignoring facts but adding the social interaction dimension into developing fuller understanding. Second order requires, in fact demands, that we first ask how others perceive a situation. Why do others have differing perceptions of the same phenomena? What commonality exists? What are the major differences that could cause problems or friction within an improvement team? What are the agendas of the team members? Are they compatible or at odds with each other? Second order compels us to look under the skin to the underlying assumptions and prejudices of the people, who are the actors within the situation. If we are to understand situations and treat them as opportunities to improve, we must not only understand the nature of the event in a first order factual manner but also understand the understanding other people have of the same event, in a second order understanding.

To understand second order understanding we can envisage a three-legged stool. With the three legs representing the elements of 'cognition, otherness and language' supporting the seat representing 'second order understanding'. Like the stool, second order will collapse if one of the three elemental legs is missing.

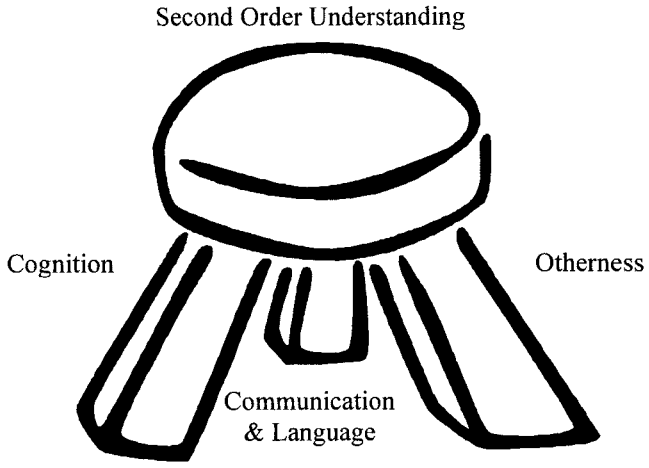

Figure 4, The Three Legged Stool of Second Order Understanding

The three elements in combination enable understanding to emerge. If any element is missing then second order will lack a vital ingredient and emergence simply will not take place. Reflection on the three elements, the roles they perform clarifies the need for all three.

Firstly, cognition of how we as individuals build our mental model of the world is required, this is the first stage on the road to second order emergence. We begin the journey when we come to understand our selves, as we step back from blind acceptance of preformed opinions and prejudices as representing a true and full picture of reality. The actual realisation that, as members of the human race we will carry with us into every event, every observation, a worldview clouded by culture, biased by education and

incomplete, is a required self-acknowledgment, that must be made before progress towards second order understanding is possible.

> *"Cognition in the autopoietic view is no more and no less than a living system's effective behaviour within its domain of interactions. In other words, cognition is a matter of interacting in the manner(s) in which one is capable of interacting; not processing what is objectively there to be seen. 'Living systems are cognitive systems, and living as a process is a process of cognition".*
> *(Maturana & Varela, 1980)*

Living systems are cognitive systems within a social context. Knowledge is born within this social context and therefore has a cultural context (Wright, 2008). Culture programs people into reacting to events in one way rather than another. Individuals interpret and interact to events in ways acceptable to their cultural background. Culture influences how we go about our daily lives and shapes our underlying subconscious beliefs when interpreting reality. Culture incorporates moral and religious beliefs, laws of society, the strategic direction, goals and mission of our organisations. Culture is inescapable as it is part of our being: forming and shaping the basic rules of the society in which we live. UNESCO (2002) described culture as follows:

> *"Culture should be regarded as the set of distinctive spiritual, material, intellectual and emotional features of society or a social group, and that it encompasses, in addition to art and literature, lifestyles, ways of living together, value systems, traditions and beliefs"*
> *(UNESCO, 2002) Universal Declaration on Cultural Diversity.*

Culture is not static, it is naturally dynamic, it must be, or human development would never have taken place. It is an epistemological quality, humankind made construction, differing from society to society and therefore a reflection of that society's common theme of reality. Knowledge, new ideas and discoveries drive the dynamics of change. The accepted truths of how the world worked years ago, is outdated in today's terms, progress and change marches on. New theories of how the world operates emerge; new ways of seeing the world we inhabit develop from new understandings. For example, we no longer believe the world is flat or that the sun revolves around the world, yet at one time those

beliefs were the generally accepted truths. Within the world of research, we try to be as impartial and objective as possible. However, total impartiality along with total objectivism is not possible (Umbleby, 2004). Observers are human beings and therefore, autopoietic systems and as such can only interact in ways consistent with how they perceive the world. Observers may be scientists, engineers or sociologists, they may be highly educated and trained, they may claim to be impartial and unbiased in their thinking, but they are still human beings only able to see what they are capable of seeing. They bring to observations as Maturana & Varela (1980) make clear, a limited set of possible cognitive interpretations and interactions. The point being, the observer will not know the part played by unseen phenomenon, irrespective of how significant those unseen phenomena may be. If as observers, we accept that we interpret our observations through our biased incomplete view of reality, we then can accept other individuals observing the same event will do the same. That is not to say observation interpretations are deliberately biased. As 'persons' we can only evaluate observations through the means open to us and those means are not impartial or unbiased.

Once an individual has developed self-understanding, it becomes possible to recognise the 'otherness' of people around them, (Johnson, 2007), this is the second of the three legs. In recognising 'otherness', we see the differences between people, more importantly we see the differences in interpretations' of the same event. Allowing others their opinions, we do not automatically discount thoughts and opinions that are not the same as our own. We may disagree with those opinions, however in recognition of the other person as a thinking knowing being; we recognise that to them their worldview is a valid interpretation of reality. Recognition of 'otherness' is then the essential second leg of the three-legged stool of second order understanding.

In the acceptance of otherness, we are entering into a relationship with another individual. In Krippendorff's (1996) terms, it is an 'I-Thou' relationship. 'I-Thou' is the ultimate relationship for second order understanding. Such relationships are between individuals in a harmony of equality, with each recognising the other as an equal partner in the relationship. Neither partner imposes their will or opinions on the other. Individuals are able to speak for themselves, sharing ideas and opinions freely, exploring the alternative opinions of others in the relationship.

The necessity of the third leg of the stool now becomes evident. Cognition firstly looks within to the inner 'self', and then looks outward to the otherness of people encompassed in the same situation. However, to explore the differences of otherness, we must have a means of communication, spoken or written communication can only be with a common language. How else can one individual transform his or her thoughts into communicable theories and ideas without using language? Generation after generation have utilised language to transmit messages between individuals and groups. Communication begins with the everyday language used by our society as a whole. From this general language, specialist languages such as the language of medicine, science, mathematics, engineering, accounting, computing and countless others have been described by Clements and Kuperberg (2008) as being developed and agreed by the individuals and groups that use them. Language has evolved as a means of communicating concepts, theories, thoughts and ideas. Communication can also prove problematic. People must feel able to exchange ideas: the dimension of trust must exist between individuals taking part (Church, 1996). If for whatever reason, fear of ridicule by others, will cause people to withhold from a full and frank exchange. It becomes extremely difficult, almost impossible, to understand an individual who for whatever reason is afraid or refuses to communicate with others. Some level of understanding could develop however; it will fall short of an understanding conducive to improvement.

The three themes, 'cognition', 'relationships and otherness', 'communication and language', working together bring the possibility of second order understanding. The word *possible* must be used here as that is the case, second order is **possible** even **probable** but certainly not guaranteed. The existence of the three legs does not ensure second order understanding will result, yet without the three legs, second order is impossible. Consequently, knowledge is born within a cultural climate of otherness and communication. While the three legs are essential, people may not elect to listen to the others, proclaiming that their view is correct and all other views incorrect. That irrespective of what others think, "*I am the senior team member*" thus using a position of authority to railroad a particular view or opinion. When a dictatorial stance is utilised to enforce one view second order understanding becomes impossible, no interaction that exchanges opinion can take place. Once an individual uses his or her position of authority to override input from others, dictatorship not dialogue results.

Second order understanding is not easily achieved. Many things can prevent its development within a group. However, when second order understanding develops, a harmony comes into existence, not possible with other approaches. Solutions become harmonised, encapsulating the understanding of the group. Language develops that describes the meaning of the situation. In short, second order understanding brings a synergy, worth the effort of overcoming the problems that can be encountered in developing dialogue. Trust develops that opens possibilities for improvements not possible with first order approaches.

4.1.6 Towards a Second Order Understanding

The second order approach is also a phenomenological constructionist view. We bring forth our world, producing our own view of reality, which differs from the view of reality,

held by others (Krippendorff, 1993). This is a phenomenological perspective, with the meaning of phenomenology defined by Smith (2003) as:

> *"The discipline of phenomenology may be defined initially as the study of structures of experience, or consciousness. Literally, phenomenology is the study of "phenomena": appearances of things, or things as they appear in our experience, or the ways we experience things, thus the meanings things have in our experience. Phenomenology studies conscious experience as experienced from the subjective or first person point of view" (Smith, 2003).*

The second order process requires an understanding of others' understanding. In other words, how others' experience and understand phenomena to build a view of the world. Several versions of phenomenology exist (Smith, 2003). The two extremes being: 'Transcendental constructive phenomenology', studying how objects are constructed in pure transcendental consciousness, setting aside relationships to the world around us; and 'Realistic phenomenology', studying the structure of consciousness and intentionality assuming that it occurs in a real world external to consciousness and not somehow brought into being by consciousness. The middle road taken by the second order process is 'Hermeneutical phenomenology' and is defined by Smith (2003) as:

> *"The study of interpretative structures of experience, how we understand and engage things around us in our human world including ourselves and others". (Smith, 2003)*

This approach builds on action prior to reflection. Following Heidegger's (1962), contention that phenomenology is, *"the art of letting things show themselves,"* letting understanding develop from experience, allowing the meaning of the world to emerge through our understanding of the phenomena. Merleau-Ponty (1996) and Sartre (1964), hold the view that we interpret meaning and understanding of phenomena through our relationship with the world and other people. Smith (2003) sums up these views with the statement that consciousness is embodied in the world.

Varela, Thompson, & Rosch (1991) along with Depraz, Varela, & Vermersch, (2003) wish to understand, "*how we come to examine what we live through*". These authors are not only examining human experience, but also how we experience our own experiences. From the viewpoint of autopoiesis, experiencing and becoming aware of subjects is in the first person. Exploration of experience and becoming aware moves and changes our mental models. This reflection on the experience of how we become aware brings a new dimension to phenomenology. The second order process taps into this dimension to understand our own understanding, as well as understanding others' understanding. If we cannot understand ourselves, how are we to understand others?

Checkland (1981) developed soft systems methodology (SSM), in order to combine differing worldviews into a single view. Several differences between the second order process and SSM exist. SSM debates varying views of the world, resulting in a consensus. In fact, debate leading to accommodation between different interests is a central theme of SSM. The debate seeks the emergence of impenetrable change that will represent an accommodation of interests. The second order process utilises dialogue not debate. Understanding of others' understanding, not consensus is the difference between SSM and the second order process. Consequently, the intended outcomes of second order understanding within the research are to:

- To develop the capacity for rich autopoietic experiences.

  As living systems, we interact with one another picking up the atmosphere that surrounds us. When the surrounding atmosphere is one of ease, trust and mutual respect the experience is harmonious, allowing mutual cooperative movement.
- To emerge a language that reflects the richness of human experience.

  Language is a distinct human capacity that allows us to communicate abstract

concepts. In the development of a rich systems language, we can communicate our thoughts and ideas more clearly and accurately.

- To enrich the language of enquiry.

  This means the removal of old distinctions and introducing newly emerged distinction. This will include systems language and thinking into the vocabulary and mental models of the people involved.

Checkland's model, explored later, draws a distinction between the real world and the systems thinking world. He does not consider it necessary to develop a systems language within the individuals taking part. This means that not everyone involved is equipped with the language of research. Consequently, the language of the system does not become part of the world for all involved. For the second order, process, engagement in systems language is part of the world. People must be equipped with language to be able to understand others' and the system. Second order involves the co-evolution of language to address the situation of concern. SSM does not develop a common language in this way. However, the above is the initial view taken by the Soft Systems Methodology approach and has evolved over the last thirty years. We shall see later, when discussing systems thinking in more detail, this view has altered to encompass both social and logical streams.

As humans, we use systems as a way of explaining the world around us. We envisage the world as an interrelated set of systems, working together to deliver stability in an ever changing chaotic environment. Our world is a systemic world, a world we cannot escape, a world we must strive to understand in order to be able to improve. Thus, it is important to consider the meaning, use and implications, of a systems language in coming to an understanding of how individuals interpret the world around them.

4.2 SYSTEMS AND SYSTEMS THINKING

The most basic cognitive operation we perform as observers is the operation of distinction. It is through distinction that, we specify a unity as an entity distinct from its background (Maturana & Varela, 1987). We characterise both the unity and the background with the properties, with which the distinction endows them and specify their separateness. If the observer applies the operation of distinction recursively and thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of systems. The autopoietic epistemological perspective suggests that cognition, the distinctions we make, is conditional to embodiment. As already said, the act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact. Thus, systems are epistemological qualities and not definitions of how things actually are or occur. Observers perceive or describe systems, therefore their boundary, and their structure. Systems have become the means by which we explore and describe the consistency of situational behaviour; therefore, descriptions of system structures are useful tools. While systems are epistemological concepts and not true reality's; if some form of agreement can be reached about 'what a system does', its purpose for being (Beer, 2000) then it is possible to communicate about its structure and boundaries with greater, in relative terms, coherence.

'Systems thinking' is an evolving body of knowledge that looks to outline and develop the concept of systems within a generic framework of principles. The Systems approach has proven its merits (Flood and Jackson, 1987), it is not the purpose of this review to discuss them. What is important, is to reflect on and appreciate the theoretical stance that the observer has to be included as part of the system. The systems thinking approach makes conscious and formal use of the concept of wholeness, as captured in the word system. The concept of a 'system' embodies the idea of a set of elements dynamically related

through their interconnections, each of which can affect the performance of the whole (Beer, 2000), however, none of which can have an independent effect overall (Ackoff, 1994).

A system exhibits as a single whole, with emergent properties which have no meaning in terms of the parts of the whole (Ashby, 1956).

> *'The system concept, the idea of a whole entity which under a range of conditions maintains its identity, provides a way of viewing and interpreting the universe as a hierarchy of such interconnected and interrelated wholes'. (Checkland, 1981)*

Additionally, Clemson (1996) reminds us that it is almost impossible to outline an area of concern with groups of people without simultaneously, outlining a system central to that concern. While Forrester (1991) makes it clear, we all speak of systems, computer systems, education and governmental systems, economic and social systems to name only a tiny proportion of the systems we encounter on a daily basis. Few realise just how pervasive and influential systems are. We spend our lives embedded in systems and can invariably trace the problems that confront us back to one or another 'system' (Forrester, 1991). Definitions of system concepts embody an approach that encourages an exploration of the relationships between elements. Unlike reductionist methodologies that concentrate on the properties of the individual elements themselves (Senge, 1990). Further, there is an implicit implication that the dynamic interactions of their components govern the operation of a system. A system's conduct, should be classified and analysed through the patterns of its behaviour, or its trends, not through seeking to predict system events. Most people would think of systems as having a systematic nature. That a system operates in a methodical manner, classified by its component parts operating in a deliberate and regular fashion. While this may be true of simple systems, as complexity increases this becomes less the case. Checkland and Scholes (1998) point out that the word systemic with its concept of affecting systems in its entirety is a far more important. The term systemic removes the idea of separate components working in isolation; replacing it with the

concept of components that work harmoniously in performing the function of the system. This concept is summed up by Gerber (2008) in his study of the entrepreneur as a system thinker in business management when he says:

> *Systems thinking is holistic thinking. It puts the pragmatic and the idealistic, the ends and the means, the process and the methods and the people and the tools and the results and the metrics of all of that, under one glass, under one vision, under one perspective, under one entire scan of interest, to make sense out of fragments that by themselves make sense, but only to a limited degree. Gerber (2008)*

The systems concept begins with the core idea that a system has properties and exhibit behaviour. Attributes that refer to the system as a whole are meaningless in terms of the component parts. Put another way, for systems and systems thinking, the idea of emergence and the well-known expression that 'the whole is more that the sum of the parts' holds true. Considering a system to have emergent properties, itself leads to the implication of systemic reality consisting of hierarchical layers (Beer, 2000). Hierarchical here describes not the layers of authority, but the development of system complexity. Thus, each layer shows emergent, observable properties, defining and encapsulating that layer, showing greater levels of complexity as the layers move out from the centre. Beer's (1959, 1981b, 2000) recursive viable system model reflects this system concept of encapsulation, systems contained within and containing other systems.

In addition to emergence and hierarchy, two more concepts define systems thinking, these concern 'survival', especially important with autopoietic systems (Tsuchiya, 2007). The concepts are communication and control, thus enabling adaptive responses to perturbations from the systems environment (Checkland & Scholes, 1998). While no common definitions exist, an examination of accounts by Atkinson and Checkland (1988) found many similarities. Their findings show, authors use the same group of ideas and concepts of emergence and hierarchy standing alongside communication and control. We can then think of a system in the metaphor of an emergent adaptive complex layered holistic entity,

which is able to survive in a changing environment. The Systems Approach includes a set of theories that attempt to rigorously explore, analyse and diagnose systems behaviour, i.e. Viable Systems Model (Beer, 2000), Soft Systems Methodology (Checkland, 1981), Systems Dynamics (Senge and Sterman, 1992; Forrester, 1994), complexity and emergence (Nicolis and Prigogine, 1989). These authors and more have endeavoured to explore the systemic world from varying standpoints. Yet all agree that a holistic systems approach, gives a view of the world in the round not available by other means.

4.2.1 General Systems

Systems science began in the nineteen forties and fell into two main categories, Checkland (1981) considers the first form to be work on general principle of 'wholeness', applicable to any conceived 'whole. However, he points out that it is not the intention to formulate one theory to cover all. The intention is, to develop general theories applicable to multidiscipline situations. The second form focuses on specialised disciplines, for example Systems Dynamics (Forrester, 1989). Wholstenholme (1990) considers this an example of philosophical naivety but nonetheless recognises the practical utility of these treatments.

General system theory began with the biologist Ludwig von Bertalanffy who began to formulate his ideas as early as the mid nineteen thirties. He explained that while he thought of the theory in 1936 he hesitated until 1948 to publicise his thoughts, when he thought the climate was more receptive (von Bertalanffy, 1968). His thoughts were that if multiple disciplines pooled their research and development, then general laws that apply to many systems would emerge. This would then allow researchers to make sense of characteristics such as wholeness, differentiation, order and progression. With such a common framework, researchers could communicate their findings and build upon each other's work.

> *"There exist models, principles, and laws that apply to generalised systems or their subclasses, irrespective of their particular kind, the nature of their*

> *component elements, and the relation or 'forces' between them. It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general (von Bertalanffy ,1968)*

With the above quote, von Bertalanffy proposed a new discipline of general systems theory. At the time, the traditional scientific method worked on two assumptions. Firstly, any system could be broken down into its individual components. This would then enable each component to be analysed as an independent entity. Secondly, addition of the independent component analysis will fully describe the system. Von Bertalanffy proposed that these assumptions were wrong (Walonick 2004). Contrary to the above two assumptions, a system is characterised by the relationships and interactions of its components not just the components themselves. Therefore, the independent analysis of components will actually lose the characteristics that form the essence of the system. This interplay of interactions between components defining the system is termed wholeness (von Bertalanffy, 1968). General system theory is a general science of wholeness (Umpleby & Dent, 1991; Checkland, 1981).

Systems in the real world obviously vary enormously in size and complexity. A small electric motor is a system, as is a complex organisation. Nevertheless, it is possible to say that all systems share certain attributes. Ackoff (1981) defines a general system as two or more elements that satisfy the three following conditions; firstly, the behaviour of each element has an effect on the behaviour of the whole. Secondly, the behaviour of the elements and their effects overall are interdependent and finally, however the system subgroups of the elements are formed, each has an effect on the behaviour of the whole while none has an independent system effect. Put simply, systems cannot be divided into independent parts without the loss of some important properties displayed by that system as a whole (Ackoff, 1981). It is possible to define any system with reference to four attributes or variables. These attributes are:

- The systems function, what function does the system perform? What role does the system play within the overall picture of reality? Why does the system exist?
- The systems structure, how the system is put together. What elements make up the system?
- The systems processes, what processes are taking place within the system to fulfil its function?
- The systems boundaries, what forms part of the system and what does not? What and who are affected by the system function and processes?

The above four elements can be used to give shape and meaning when discussing or describing any system (Beer 2003, 2000; Ackoff, 1981). Both propose the boundaries of a system are dynamic entities, dependent upon the person defining them. The identification of purpose and positioning of the boundary is critical. Boundary positioning encapsulates the issues and scope of subsequent action. We can class them as first and second order boundaries. First order looks inwards, into the system at facts and data, ignoring people. Second order boundaries include people, and look outward from the system into the wider environment to encompass opinions and perceptions of the individuals affected by and affecting the system.

People will place the boundary in accordance with their view of the system and it purpose. Therefore, the boundary set by an individual from the marketing department will differ from that drawn by someone from production or research and development, the accountant another, and so on. Boundaries will also differ even within the same department or section. It is tempting when possible to redraw the boundary to encompass all opinions as a simple way of obtaining agreement. This action will increase system complexity as the boundary extends outwards to encompass more variation. Churchman (1970, 1979)

maintains that the boundary must be set to sweep in as much understanding as possible, thus creating a rich and complex picture, without compromising the meaning of the analysis. However, Ulrich (1983) points out that the purpose of the analysis will impose limits to the possible placement of the boundary. Therefore, boundary placement is critical in defining the systems area of influence. Second order boundary placement defines the actors within the system, when coming to an understanding of differing worldviews and opinions. The purpose of a system will also be dependent upon the person making the definition. A student could define the education systems purpose as, a system to educate people. While those employed within the system, teachers for example, may define the purpose as a means of providing finance. They probably also consider the education system as providing education, however the point is that their perception of the education system will differ from that of the students.

Von Bertalanffy (1968), followed by Havener & Thorpe (1999) and Umpleby (1999) examine the two basic differences of open and closed systems within general systems theory. Open systems consist of natural living systems. However, the term 'living system' is not restricted to biologically alive systems, but to a wider context of adaptive autopoietic systems. Open systems can change, adapting and evolving to meet changes in their environment. Such a system is active and at its heart is a transaction between two principle parties. In commercial enterprise, the transaction is between the supplier of a product or service and the customers of that product or service (Havener & Thorpe, 1999). The question is, 'for what purpose does the transaction occur?' In answering this question, everything else about the system becomes clear. Its function, structure, processes and boundaries all flow from and must be compatible with the answer. Closed systems are mechanical and repetitive. By definition, they are incapable of self-adoption or change (Havers & Thorp, 1999). Such systems do not recognise environmental change; they perform the same task in a repetitive manner, inevitably becoming out of date and obsolete.

Closed systems are isolated from their environment (von Bertalanffy, 1968). An open system on the other hand assimilates inputs from its environment and excretes waste products in order to maintain its identity (Midgely, 2000). Open systems change, adapt and evolve. They are independent from but responsive to their surrounding environment, that is itself an open system at a higher level of abstraction. The important distinction is that while open systems are dynamic and adaptive, closed systems are static and fixed. While the proposition that open systems assimilate environmental inputs and excrete waste back into the environment, gives an initial feeling of living breathing systems, the term is equally applicable to organisations. If we consider raw materials as environmental inputs and unwanted by-products as waste and responses to changes in customer, governmental or other organisationally external requirements as environmental adaptation, we have the initial requirements of an open autopoietic system. Organisations adapt to change, evolving as the environmental perturbations from customer's legislation and other requirements bring about commercial pressures to adapt or die.

4.2.2 First Wave: First Order Systems

Systemic Organisational first order research relied entirely on scientific methods excluding any human aspect. Employing several methods centred on mathematical philosophy, the best known are 'System Dynamics' (Forrester, 1961), System 'Engineering' (Hall, 1962), (Jenkins, 1969), 'Systems Analysis' (Quade &Boucher, 1968). 'System Dynamics' use feedback process models to consider impacts of change on systems, while 'Systems Engineering' focusing on the design of whole organisations and 'System Analysis' is measuring cost effectiveness. These methods ignore observer impact. The main identifying factor is the assumption; observers are independent of the observed and a single true reflection of reality results, which is the only true reality possible. Furthermore, it is possible to code reality into a set of variables and formulas represented in a mathematical model of the system. First order systems comprise a set of activities, which bring together

and create a complex model that represents a man made entity we call a system. They are predominantly concerned with the information flows and the models used to depict such a system mathematically. Analysis geared to establishing the costs etc of meeting defined requirements, is also a hallmark of first order systems. First order, referred to as hard systems thinking, works well with clearly defined and established needs. The belief that all real world problems are capable of mathematical interpretation is a main characteristic of first order systems (Checkland, 1999). However, not all problems are capable of formulation into mathematical models. Problems that have people based, social components do not fit into first order system engineering models. For these problems, a new approach was required. This approach came to be known as second order systems thinking.

4.2.3 Second Wave: Second Order Systems.

The idea of second order systems practice implies a desire to find ways of using systems concepts in resolving problems (Checkland, 1981, 1999). Second order systems move into the arena of socio-technical systems thinking, having the core idea that organisations have both a social and technical component. Addressing these two components in unison is a critical requirement; separation would result in two sets of measures that would not be compatible. This branch grew from the combination of human relations, psychoanalysis and quantitative applied science. The viable system model (Beer, 1959, 1981b) with its recursive element, feedback and human intervention control systems, represents such an approach. The second order movement grew from growing doubts with regard to first order thinking.

In the late sixties and early seventies, doubts as to the validity of first order started to appear. Directed towards organisation research authors such as Churchman (1970), de Geus (1994) and Rosenhead (1989) began questioning the underlying philosophical

assumptions of first order approaches and the consequences of their application. Criticism arose regarding the view that system models actually represented reality. The belief that rather than represent reality, system models were only an aid to developing understanding grew (Churchman, 1970) (de Geus, 1994). First order approaches had no people involvement; they made recommendation for change, without involving the people tasked with carrying out actions. They also tend to ignore the individuals affected by implemented change. It becomes a possibility; stakeholders will oppose and fail to implement the recommendations, in some cases actually working against change (Rosenhead, 1989). First order also came under criticism for viewing human beings, as inanimate objects instead of people with goals of their own (Checkland, 1981). Concern grew that the first wave of systems approaches with emphasis on quantitative data applied science and dualism, failed to see the value of including system stakeholders. Finally, first order systems assume that a systems project is unproblematic, when in actuality the goals of the project are often unclear because multiple viewpoints are ignored (Jackson & Keys, 1984). This also allowed the practice of taking the view of the person providing the money to finance the project and ignoring others' opinions (Linienfeld, 1978; Jackson, 1991). Authors such as Churchman (1979), von Foerster (1979), and Habermas(1972) began to rethink cybernetics and systems thinking. It became obvious that a first order approach was inadequate, that a new method of thinking was required to deal with messy problem situations. Checkland (1981) has described messy problems as ill defined, characterised by their complexity in terms of cause, consequence and social context.

Von Foerster (1979) came up with the phrase 'second order cybernetics' and moved the emphasis from the observed to the observer, emphasising that different observers perceive things differently. Adding the idea that an observer is unbiased and objective is nonsense. Churchman (1979), Akoff (1981), Checkland (1981) and von Foerster (1979) led the crusade to change hearts and minds to the second order paradigm. However, this flew in

the face of the scientific thinking, accepted for centuries. The new thinking turned the notion of separation of the observer from the observed upside down, insisting that the observer is part of the observation and there is more than one view of reality. However, while some disagree, most people within the cybernetics and systems field have accepted second order ideas (Umpleby, 1991).

Since 1974, von Foerster and his colleagues have worked to establish this new way of thinking. Meeting success within systems thinking and cybernetics community, however in the wider scientific community there has been a lesser impact. Von Foerster (1981), von Glasersfeld (1987) and Maturana and Varela (1988) have been working on developing second order cybernetics and the importance of dialectic intercourse in the generation of knowledge. They have worked on the premise; complex systems contain thinking individuals each with their own view of the system. The outlook that observers are not separable from their beliefs, that observations must therefore reflect these beliefs is central to second order systems thinking. Stuart Umpleby (2001b) defines the work towards second order as follows:

> *"I have been a member of the group of people who worked to develop the ideas of 'second order' cybernetics and to arouse interest in these ideas among academics in a variety of disciplines. In the language of Thomas S. Kuhn we were attempting to make a scientific revolution. A scientific revolution is marked by the emergence of "incommensurable definitions." Consequently the differences between first and 'second order' cybernetics were repeatedly stated. The way others and I defined the differences are summarized in the following Table.*

Table 3, First and Second Order Definitions

Author	First Order	Second Order
von Foerster	**The cybernetic of observed systems**	**The cybernetics of observing systems**
Pask	**The purpose of a model**	**The purpose of a modeller**
Varela	**Controlled systems**	**Autonomous systems**
Umpleby	**Interactions among the variables in a system**	**Interaction between observer and observed**

> *After about twenty years of making the case for 'second order' cybernetics, it seemed to me that we had largely succeeded. The idea of perspectival observation – what a person sees depends upon his or her background has become widely accepted in scientific circles". (Umpleby, 2001b)*

Second order systems thinking as Umpleby states above has become widely accepted within the systems community. However, there are people such as Masani (2001) who fervently disagree with second order concepts, nevertheless the general systems community agrees.

Additionally a third wave has begun to develop as an extension to second order systems thinking. Growing slowly, the third wave has begun to include not only the observer, as did the second wave, but all the individuals included within the observed situation. Unlike the quantum change from first to second order, this movement has been gradual, growing from the work of von Foerster (1981), von Glasersfeld (1987), (Maturana and Varela (1988) and others such as Umpleby (2001b) who asks 'what comes after second order?' Power relationships are a missing component from the original second order. These relationships become vitally important to the successful use of dialogue, with its philosophy of each person being equal and the suspension of hierarchy. The work of Champion & Stowell. (2001, 2003) into PEArL a form of SSM incorporates power relationships into the process. PEArL is moving in the opposite direction to the second order process in deliberately engineering conflict and the use of an individual's power to

direct actions. However, can you really bring managers and their subordinates together and expect them to speak freely without the fear that one party or the other will use another's comments later for their own ends? Thomas and Locket (1979), Mingers (1980, 1984) and Jackson (1982) all make this observation. Not withstanding the above reservations, 'dialectics, resolving difference by finding truths on both sides, rather than one opinion overpowering others as in PEArL, forms the basis for knowledge generation and understanding between observers and the stakeholders affected by change. We all have our own interests and ways of knowledge construction. Habermas (1972) suggests we have three inherent interests:

- Technical: in predicting and controlling our environment
- Practical: in achieving mutual understanding
- Emancipation: in freeing ourselves from power relationships

The third wave brings these considerations to the reality viewed by an observer. It has seen the birth of critical systems thinking and pluralism, Jackson (1987), Midgley (1992) and Mingers (1997) draw on Habermas (1976, 1984a, 1984b) three worlds to support methodological pluralism in the continuing development of the third wave.

4.2.4 Reflections on Systems & Systems Thinking

The development of systems thinking has brought a new way of understanding the world around us. Von Foerster, von Glasersfeld, Maturana and Varela have championed the move to change from the first order 'object subject' approach to the second order of multiple worldviews.

First and second order understandings of systems undoubtedly differ. Second order systems thinking and understanding contradicts the dominant positivist scientific tradition of first order thinking. Second order understanding is altogether different from first order

understanding. Natural scientists had followed the belief that observers are independent, impartial and unbiased for centuries. However, it is incorrect to start from the assumption that human beings are rational machines, act alike, or live in the disembodied universe that scientists construct. In practice, second order understanding means acknowledging not only where understanding is embodied, but also who else holds that understanding. Second order understanding is inconceivable from a first order point of view, accounting for the blindness in not seeing what the second order approach brings to deeper understanding (Krippendorff, 1997). The second order approach can be found within numerous approaches to organisational improvement. The Appreciative Inquiry Method (AIM) and the Soft Systems Methodology (SSM) approach being two of the best known and taught within the systems thinking world.

Over the last thirty years, Peter Checkland has been developing the Soft Systems Methodology theory as an action research approach to organisational improvement. This has been one of the main second order system thinking approaches to action research within the systems movement in the United Kingdom. Checkland's original model is shown below as Figure 5.

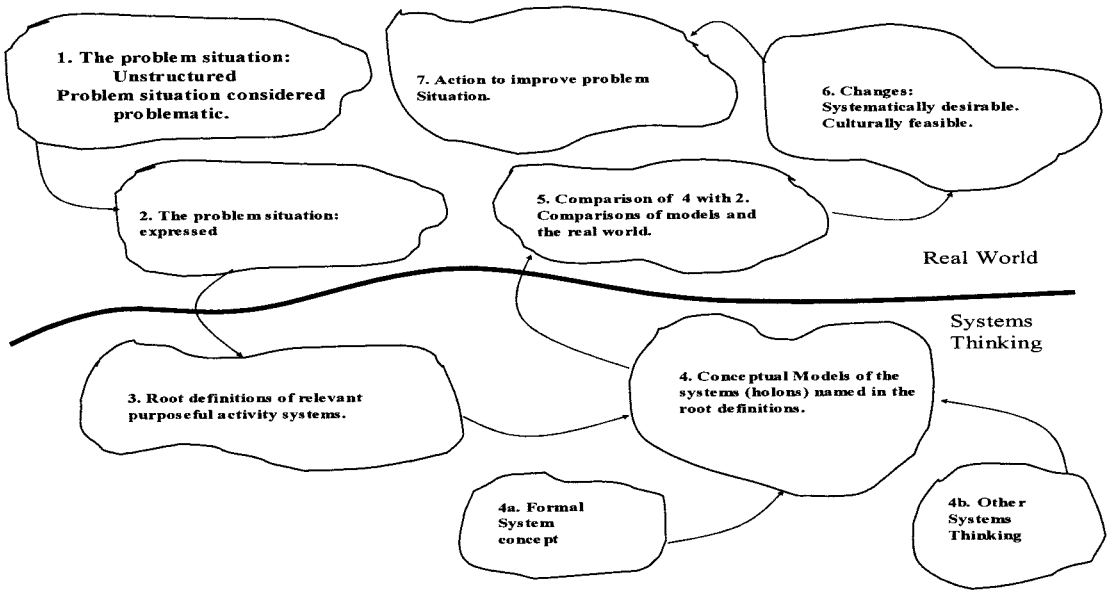

Figure 5, Checkland's Seven Stage Soft Systems Methodology Model

The model above is used to evaluate what Checkland termed 'human activity systems' (HAS), to compare differing worldviews within the real world. Stages 1, 2, 5, 6, and 7 are real world activities, while 3 and 4 are system thinking activities. As the model shows this is a movement from the real world into the theoretical world of systems thinking. However, in his thirty year reprise Checkland (1999) comments, this original seven stage model known as model 1, should not be followed slavishly as it simply shows a logical structure to action research. The seven-stage model is easy to understand and in the words of Checkland "*easily taught*". However, this model can mislead and give the impression that stages 3 and 4 take place in some sort of systems thinking hyperspace removed from the real world. This misconception is one that individuals newly introduced to Soft Systems Methodology can easily make. The second implication is that to engage in steps 3 and 4, knowledge of systems thinking theory is a prerequisite. However as time has passed Checkland has developed a model of the processes taking place within action research that is more representative of the logical and cultural streams that coexist within systems and runs in parallel during an improvement activity known as model 2. For more information on this later model, see Checkland and Scholes (1998). While more difficult to understand than the seven stage model shown as Figure 5 and requiring skill, talent and experience to use (Arnson, 2003), it emphasizes that within an action research program, there are two streams running in parallel. Both of the streams are required: the logical stream deals with the ideas and worldviews of individuals while the social stream deals with the political environment surrounding the situation. Examining the logical stream shows the task of developing models of the system under investigation. These models are compared with what Checkland terms the real world. Noting the differences the models are re-evaluated and adapted to accurately reflect what is accepted as reality. It must be remembered that each individual involved in the organisational improvement team (Consultants, Manager's Members of the system under review, anyone involved in the improvement team) will all

be involved in production of their own ideas and models in the early stages of the enquiry. Later in the process, a consolidation of several models in to one group model that depicts the world of the system as seen by the group as a whole takes place. Consolidation of several individual views into one group view is one of the main themes of SSM. In coming to this single group view, the cultural stream comes into play. Soft Systems Methodology uses discussion and debate not dialogue to come to a joint decision. The aim being to make a group decision not come to understand the worldviews of the others taking part. This is a critical variation from the second order understanding process.

Arnson (2003) describes the two types of problems encountered within systems thinking action research as 'difficulties' and 'messes'. Difficulties may be intricate and complex but well defined. The problem itself is likely to be well defined, the people involved in agreement as to its nature. A difficulty will only affect a small number of events and people, with political and ethical aspects playing a limited role (Armson, 2003). Difficulties have a limited set of things, events and people involved. This is typical of first order systems. For such problems first order object subject approaches are suitable. For example in fields such as civil engineering where the loads, stresses and strains on materials plays a vital part in the design and safety of structures, mathematical models and equation are not only applicable, they are essential. This argument is also true for engineering, pharmaceutical or other problem that entails the use of numerically accurate data. To say there is no longer a place for first order approaches is incorrect, instead it can be stated that first order and the scientific method is not suitable for all situations (von Foerster,1979).

Arnson's, (2003) second type of problem described as a mess, is altogether a more difficult problem situation to define. Among the characteristics of a mess is that they are ill defined, contain a large content of human interaction and the boundaries of the system or

systems involved seem difficult to establish. There will be little or no agreement of what the problem actually is. This in turn makes it difficult to visualise what solutions are possible. Not only is there a lack of information, it is difficult to ascertain what information is required. These uncertainties will generate a sense of unease around the problem. The problem seems multifaceted, with a large degree of interconnection between systems people and processes. Finally, human values often conflict and form a contributory factor to the problem (Arnson, 2003). Obviously, a mess is a second order situation, requiring second order approaches. Nevertheless, Arnson has remained with the traditional philosophy of seeking consensus, thereby remaining short of understanding of others' understanding

The culture of an organisation has a determining effect on any team activity. At one end of the spectrum, in a closed command and control culture it is difficult to envisage any form of second order approach being possible. The political atmosphere in such an organisation would tend to lead to a top down instruction philosophy being the norm, as within the armed forces for example. In such a culture, discussion and debate would be unlikely; with instruction and allocation of actions by management being the normal way of doing things. At the opposite end of the spectrum to closed cultures, open cultures actively encourage individuals to take differing views on possible approaches and actions that will lead to improvement. Second order requires and will thrive in an open culture. However, even in an open culture, management in giving general strategic direction without stifling individual creativity must exercise some degree of control. The cultural stream can clearly be seen in the CATWOE phonemic of the Soft Systems methodology. CATWOE gives the six crucial characteristics that should be included in stages 1, 2, and 3 of the seven stage model shown in Figure 5

CATWOE is used to identify the main areas of interest within systems thinking action research, beginning with *Customers,* or the people affected by the research. However, the term customers must be seen in a wide context it relates not only to the beneficiaries but also the victims of change. *Actors,* are the people who will actually carry out the *Transformation* from the current undesired situation into the required desired situation. However, the *Weltanschauung* or world view is used to place the transformational process into context. Weltanschauung considers the bigger holistic picture into which the situation fits, what the real problem is and what the wider implications of the transformation are. The differing Weltanschauung's give rise to the debate within the team as to the cause and method of problem rectification. SSM uses debate of the varying views to come to one agreed view that is acceptable to all. *Owners* are the individuals that have the power to cancel or amend the aims of the transformation process. The final letter in the CATWOE numeric represents the *Environmental* contracts placed on the possible alternative transformational actions. Environmental constraints may be imposed by the wider community external to the organisation through legislation, additionally financial constraints, limited resources or time limitations may all act as environmental concerns.

The Appreciative Inquiry Method (AIM) grew from the ideas of SSM. AIM is related to the work of Checkland (1981, 1999) and Vickers (1981, 1985). Vickers notion of the appreciative system was one based on relationships. While not as detailed as the 'I-It' to 'I-Thou' relationships of Krippendorff, Vickers highlights the importance of an organisation's ability to maintain its relationship with the environment. He also suggests, the principle responsibility of any manager is to take action to maintain the environmental relationship. Additionally such relationships are dynamic; ever changing and evolving and therefore a continuing knowledge generation process is required.

While SSM and AIM, are second order thinking approaches, they do not require second order understanding. These methods require a consensus within the members of the team. An agreement is arrived through debate by the replacement of one opinion by another. Second order understanding requires more than team consensus. The requirement is for a shared view, one that accommodates the varying opinions of the team members. This difference between second order thinking and second order understanding is a shared vision. A shared vision, allowing the team to hold the same mental model of how they want things to be (Senge, 1990), a vision willingly agreed by all the team.

4.3 REFLECTIVE DISCUSSION DRAWN FROM THE THEORETICAL PERSPECTIVE

That we exist in an epistemological world of systems is borne out by Umpleby (2001, 2001b), Spon (1964), von Bertalanffy (1968), Forrester (1991), Checkland (1981) and Kripendorff (1996, 1997). Systems influence human activity, directing action and shape organisations and communities. An improvement activity in whatever organisational sphere inevitably requires alteration to one or more systems. Recognition of the system and systems nature of organisational life in particular and life in general, is the first step in a systems thinking approach. SSM and AIM, as mentioned previously are systemic approaches to action research, based organisational improvement however, they are not second order understanding approaches. These methodologies use discussion and debate to reach consensus (Checkland & Scholes, 1998; Champion & Stowell, 2001, 2003). While the method of communication required for second order understanding is dialogue (Cordoba & Farquharson, 2008). It is possible to think of first and second order systems in the following way. First order has fixed method of operation, with no human involvement, machine tools, motor vehicles, electrical equipment are examples. We can think of a computer network system in this way. However, when we think of how people use a computer network, emails for example we move into a second order category. In such cases, the first order computer system allows the person-to-person second order interactive

exchange of information. A second order system has a central social context that involves understanding people's views, increasing second order complexity, with greater possible variation and the ability to adapt to a changing environment.

To understand a system, we must understand the actors within that system. To do this we need a method of communication. Debate is counter productive to the development of second order understanding. When debate is used, an adversarial situation is inevitable. Within debate, one view becomes dominant seeking to override through persuasion all others opinions and views. What is required is Bohm's (2000) type dialogue, a method that does not seek to overpower others' ideas, but explore and contrast them. That dialogue is a difficult form of communication to practice, is an understatement. However, dialogue is the most suited to the exchange of ideas, thoughts and opinions essential to the development of understanding of others' understanding.

Having accepted dialogue as the communication leg of our three legs of second order understanding, we must examine our own opinions views and beliefs, if only to be able to verbalise them to others. The understanding of other individual's understanding begins with self-understanding (Krippendorff, 1993). Internal examination of the self enables the surfacing of prejudices that influence our opinions. We can then bring these underlying themes out into the open for examination by others within the dialogue. As systems thinking has moved from first to second order with third order bringing political and ethical considerations into action, new research approaches become necessary (Umpelby, 2001b). Second order understanding takes action research into the realms of co-creating meaning and shared vision, from the interaction and emergence of a single worldview that no one member of the team claims as their own. Second order understanding creates Krippendorff's (1996) 'I-Thou' relationships that are people in conversational dialogue. A relationship that is between equals with no single claim to an overriding purpose or

universal truth. Krippendorff (1996, 1998) Bohm (1987,2000), Hodson (2002), Holquist (2004) and Piaget (1995) all agree, reality is in the eye of the beholder. Reality is an interpretation for each of us, an interpretation made for knowledge gained from experiences. A view that allows us to see in the ways we can see and blinds us to things we can not (Maturana & Varela, 1981).

From a SSM perspective, Cordoba & Farquharson (2008) have concluded that SSM is a *"scientific discipline and knowledge generation by the scholarly community"*. They go on to conclude that for production of knowledge, as is required with organisational improvement mode 2, SSM is the preferable method. However, again these authors have not addressed the development of second order understanding.

Systems thinking is becoming a popular methodology for organisational improvement in all sectors. Seddon's (2008) discussion of systems thinking within the public sector to change the attitude of specification and inspection of conformance to standards, to one of system function makes this point. Systems thinking is a powerful method of visualising the way the word as a collection of systems operate. It shows the flaws in the traditional reductionist approach to improvement taken in the past (Seddon, 2008)

4.4 SUMMARY

This chapter has developed the theme of second order understanding. Second order understanding, is based on enactive cognition, dialogical communication and the concept of otherness. These three legs cam be summarised by recognising that other individuals will have their own valid viewpoints that must be considered. Additionally, their view is as valid to them as yours is to you. The dialogical communication includes systems language in order to allow a holistic view of the situation of concern. The second order approach is innovative, allowing and accommodating the exploration of the viewpoints of differing systems and incorporating these in the eventual solution to a situation of concern.

The key points of this approach are as follows. We need to understand ourselves before we can begin to understand others. The acceptance of the constructionist view, we will all see the world differently, based on our cultural understandings, opinions and previous experiences are central. Holistic systems' thinking brings insights not possible with a 'subject-object' first order reductionist viewpoint.

The following chapter extrapolates and embodies a model of a second order organisational improvement process discussed above.

5 CHAPTER 5: THE SECOND ORDER IMPROVEMENT PROCESS

5.1 PROCESS INTRODUCTION

From the theoretical perspectives and initial research, it has emerged that a need for an organisational improvement process based on second order understanding and system thinking principles exists. The question now becomes, 'how can a sustainable second order process be developed'? Writers such as Easton and Jarrell (1998) inform that first order improvement is difficult to sustain, while Keating et al (1999) maintain that it is not possible to purchase an off the shelf fully functional improvement process. Initially the process detailed below, emerged from a combination of theoretical principles and the emergent themes from the initial research. However, the process developed over a series of trials and subsequent refinements. Having reached this stage, the process was trialled in several iterations: two are recorded as case studies in chapter six.

To begin the development and lay the foundations for subsequent iterations, a small team of volunteers, with this researcher acting as a participating member, took part in defining a set of underlying improvement process attributes. With the help of a consultant from the 'Philosophy of Management' acting as a facilitator, a Socratic Dialogue session was held to answer the question of "*When are people willing to follow a uniform process*"? This looked at the requirements and issues affecting a sustainable improvement process. Socratic dialogue has as its basis, a mutual trust and a co-operative search for understanding that, while following defined and agreed rules of conduct, underlies the dialogical nature of second order understanding. During the dialogical session, the team followed a set of principles having the purpose of gaining an understanding of the issues and questions surrounding a sustainable organisational improvement process. In brief, Socratic dialogue encourages participants to reflect, thinking independently and critically of the issues of improvement. While philosophical training is not required, participants

must be willing to contribute their thoughts and to listen to the thoughts of others. The aim of the team is to reach consensus as a means to deeper investigation.
Socratic dialogue's main features are that: the team owns the enquiry, everything is open to review and question and those members are only human and therefore fallible.
Additionally a set of rules should be clear and concise, stipulating the way individuals taking part should, postpone prejudgment of others, seek to understand and think for themselves, express their doubts and stay specific to the subject under investigation.

While it was not the aim of the team to develop an improvement process, it was the intention to drill down into the issues, thereby evolving process design criteria and defining the desired attributes of a generic second order improvement process capable of adaptation for use within any organisation.

At the conclusion of the session, the team had developed a set of attributes required by an improvement process that people would be willing to follow.
Listed below are these improvement process attributes.

- Easy to follow
- Structured in easily manageable stages
- Adaptable to the situation at hand
- Involve all the participants
- Develop understanding of situation and other individuals opinions
- Seek consensus, no imposition of one individuals opinions on others
- Allow all team members to express their opinions and beliefs freely

The above set of attributes developed by the Socratic dialogue team was used in the development and trials of the second order improvement process as required. The process, structured into easily understood stages, can be performed consecutively or returned to, as

the situation requires. The process model shown below, seeks to improve organisational systems utilising second order and systems thinking principles.

5.2 THE SECOND ORDER MODEL

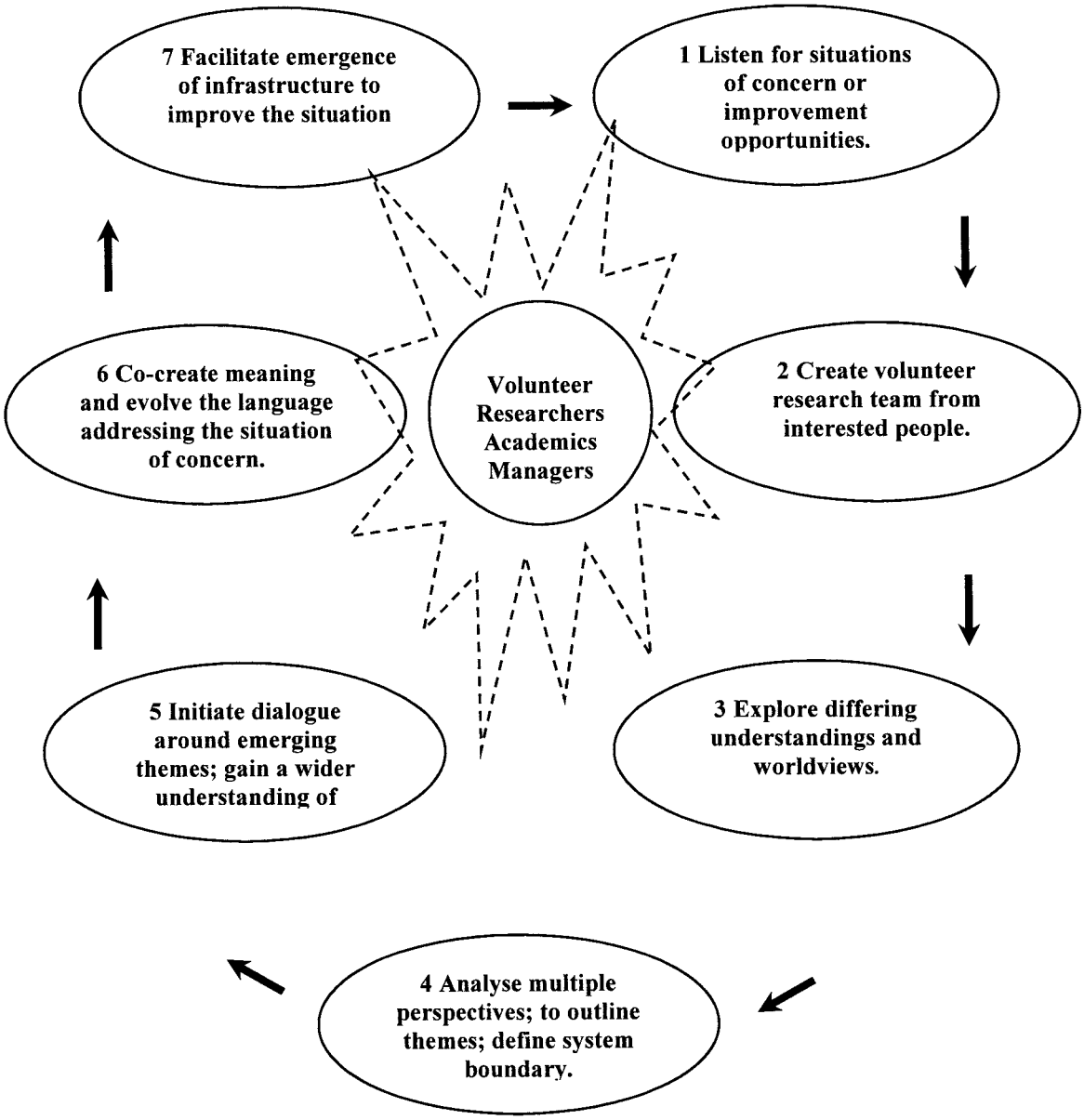

Figure 6, The Second Order Organisational Model

The model consists of seven distinct stages. Nevertheless, while the stages follow a logical sequence, this does not mean a team must follow the stages in the sequence depicted above. In most cases, the stages of the model will follow in the sequence shown. Although, there is nothing to prohibit stage use in a sequence required by the situation

encountered. The process is iterative, making it possible for the team to move from one phase to another, at times missing out stages, while at others returning to a previous stage as the need arises. The aim is to build an understanding of the situation and the issues created within the workforce affected. Improvement requires change and change will affect people. Issues will surface and there may well be losers as well as winners as a result. The second order process seeks to surface an understanding, of the implications and consequences of any changes contemplated, before that change become irreversible. The process seeks to understand the attitudes, hopes and fears, of the people affected, mitigating negative attitudes, while smoothing the way and gaining acceptance from the majority. Acceptance by all is the ideal situation, however, this is not always possible, and therefore the creation of a situation that everyone can agree to an acceptable alternative.

5.2.1 Stage 1: Listen for Situations of Concern or Improvement Opportunities

Theorists such as Deming (1986), when discussing organisational improvement maintains, it is the employees doing the job who are informed and the experts of their respective systems. They are the individuals that know the problems and possible improvements that would prove beneficial within their own areas. These individuals' should be responsible for identifying improvement opportunities and implementing changes (Deming, 1986; Ishikawa, 1985; Juran, 1969). These are the underlying principles behind stage one of the 'second order' model.

Stage-1 of the model is a process of observation and exploration by the members of the organisation. While carrying out their daily activities, all employees are encouraged but not compelled to become researches. Observing systems they have contact with, exploring the operations normally overlooked and taken for granted. The individual members of staff become involved with identification of improvement opportunities. The employees, not the management, drive the improvement process. That is not to say that management

are not involved as they also have a role to play. Management's role in this and all other stages of the model is to act as a facilitator, creating the opportunity for individuals to partake in improvement activities and ensure required resources are available.

The essence of stage-1 is that each employee has the opportunity to put forward his or her thoughts on improvement possibilities. The thinking behind the stage-1 philosophy has two principles. Firstly, the employees know and understand the systems in their area in a way management will not. Secondly, people have a commitment to change, when they are actively involved in the suggestion, planning and implementation of that change.

While the emphasis has moved, from management driven to employee driven improvement activities, management cannot be divorced entirely from the situation. The manager's must be responsible for evaluating the practicality of suggestions. The evaluation process, can itself cause problems and eventually destroy the improvement process, if carried out without sensitivity. The employees must see the process as unbiased, giving all the suggestions the same attention and consideration. The individual making the suggestion should be included in the evaluation process. Involvement will bring the twofold benefits, of increased commitment to the overall process and an understanding of issues affecting the carrying forward of the suggestion, into a management backed improvement initiative.

The outcome from stage-1 is a management validated and agreed improvement possibility. Whenever possible, the individual making the suggestion becomes the leader of the improvement initiative. However, if for some reason, the individual does not wish to lead the team, he or she should as a minimum, be a team member. Following the decision to proceed, the rough formation of the team is considered. During such deliberations, the knowledge required to develop the suggestion will identify the skills required. While this

stage develops, a representation of the skills required, the selection individuals making up a team is the function of stage-2.

It is at this stage, the need for external expertise may surface. Nonetheless, the second order process model is not action research conducted by a third party, it is action research conducted by members of the organisation, with input and assistance if required from a third party. The improvement team may require the assistance of academics or consultants to provide specific knowledge not available in house. However, in such circumstances, team leadership is not transferable to such individuals; leadership must remain with the organisations personnel. Following validation and assessment of the initial knowledge required, stage-2 the selection of the individuals making up the improvement team commences.

5.2.2 Stage 2: Create a volunteer research team from interested people.

Stage-2 is concerned with the development of the research team. Team formation is the first step towards second order understanding of others' understanding of the situation encountered. This vital stage is the foundation of subsequent deliberations and actions. Within the team, hierarchical levels, personalities and past working relationships, are among the influences that shape the possible social interaction amongst the members.

The Problem Solving Process as can be seen from diagram 1 ignores this stage. The PSP moves from step 1, problem identification, into step 2 problem analysis, without mention of team formation. This leads to team formation by '*management instructing individuals that they have to participate*'. As the interviews above, especially interview 7 and 8 make clear, team, formation within Northumberland Manufacturing is normally by dictate. The directing of individuals to join teams, without prior consultation is the normal practice. This approach does not lead to a team of committed individuals, but a collection of people

who follow the instructions of management. Such groups seek the easiest, quickest solution, as interviewee 6 makes clear with his remarks concerning reoccurring problems.

The concept of team formation is central to a wide variety of disciplines. One of the important key features of any team is the social network that determines the interaction between its members, (Newman, 2002; Strogatz, 2001). Studies of team formation and cooperation in organisational dynamics show the importance of network structures in team performance, (Huberman & Hogg, 1995). If we define the word team as, 'a group of people, working together in a committed way to achieve common objective and sharing responsibility for the results attained' (Senge, 1990). It then becomes clear; a group of directed uninterested individuals are unlikely to fulfil the criteria within the definition. A team formed from individuals who may not wish to participate, is the method utilised with the Problem Solving Process. In such cases, team members may feel, forced to neglect what are in their opinion more important tasks or at times wonder if they are just making up numbers as the initial research suggests.

The second order model takes an entirely different approach to team formation. A second order team consists of invited volunteers, from people who have a stake in the situation. As interviewee 8 suggests, a number above the one required are invited to join the team. This will allow people to decide if they wish to participate. Enforced secondment is not a method used. Such secondment would destroy the underlying concept of each team member participating from his or her personal choice. Whatever their makeup, teams consisting of volunteers, has proved more productive than teams consisting of members directed to take part. It appears that the old adage, "*one volunteer is better than ten pressed men*", is true. Consequently, volunteer teams are the option adopted by the second order model. In selecting the volunteers, the team leader must also consider team dynamics. Team consisting of individuals with widely ranging hierarchical positions, will

have the disadvantage of individuals, not wishing to openly disagree or question those considered as being in positions of authority. Likewise, individuals in authority may consider it acceptable, to use their position to enforce their opinion onto others. Both these situations result in little understanding of others and thus returning to a first order scenario.

When a team forms and is in its infancy, probably containing members that have not worked together, a process entitled 'forming' by Bruce Tuchman (!965) takes place. The team learns about the opportunities and challenges of the project. They agree goals and begin to identify the tasks required. At this point, some individuals may decide that they no longer wish to participate and leave the team. While those left, may be motivated, they need direction from the team leader. Avoiding discussion of serious issues people focus on routine issues, such as team organisation, who does what, when to meet, etc. However, individuals are forming impressions of each other and the system under investigation. The training supervisor in his interview discussed this situation. He explained that more than the number of team members should be invited to join the team, allow people to declining or withdrawing at a later point in time.

Second Order team formation, seeks to develop a group of volunteers that feel able to discuss ideas they wish to explore. Such teams require the interest and enthusiasm to improve the situation and the trust in others' present to be able to share their thoughts even when they disagree.

Several issues can arise during team formation. All organisational activities have social and political implications. No matter how beneficial an improvement may be teams need support from senior management. Without management support, no matter how much understanding of the situation develops within the team no change will be possible. The personality of individuals also has a contributing factor to the development of

understanding. Individuals with closed minds, who believe they know the actions required and are unwilling to listen to alternative suggestions, will stifle dialogue, closing the door to the exchange of ideas and development of understanding. The culture of the organisation has an overriding effect on the team. A militaristic closed command and control culture, will find it difficult to allow the formation of teams of volunteers. Such cultures are incompatible with second order approaches, seeking to dictate the actions of individuals. For second order understanding to develop, an open culture is essential, people must feel free to disagree and attempt new ways of working without fear of reprisal. Stage-2 concludes with a team consisting of enthusiastic individuals committed to improving the situation of concern.

5.2.3 Stage 3: Explore differing understandings and worldviews.

Stage-2 transforms into stage-3, almost without conscious thought from the team. As situational understanding increases and the trust between individuals' grows, the team forms and builds its structure. Tuchman's (1965) '*forming*' moves into what he describes as '*storming*' when the team moves from stage-2 to stage-3. Team members define roles and responsibilities. Storming is characterised by conflict; individuals test each other and the designated team leader for control. Clarity of purpose increases, but uncertainty remains, group relationships and factions form. Addressing important issues, the team begin the task of coming to and understanding of the understandings held by other members of the team. While the goals and tasks required are implicit as stage-3 commences, there is no second order understanding of other individuals. Each team member has his or her personal interpretation, and therefore, understanding of those goals and requirements. Each individual will develop an understanding of the situation from his or her own view of the world. Differing disciplines will create differing priorities; financial issues interesting accounts people, manufacturing issues from industrial

engineers, while people from production will be concerned with the effect change will have the ability to meet production targets.

As stage-3 evolves, team members move from conflict to co-operation, positions and responsibilities established themselves, in Tuchman's terms the '*Norming*' phase has began. A sense of team belonging establishes itself, as people get to know each other and appreciate others skills and experience with ideas exchanged freely. Individuals listen to each other, appreciate and support each other, and are prepared to change pre-conceived views.

The relationship between members that allows the appreciation, support and the ability to see the world through the eyes of the other team members, was described earlier as an 'I-Thou' relationship. I-Thou is a relationship of equals, the only one of the four discussed relationships that can lead to full second order understanding of others. 'I-You', while recognising the humanity of others, remains a hierarchical relationship. Such a relationship, excludes the exchange between equals necessary for second order. The two relationships described by Krippendorff (1996), 'I-They' and 'I-It', by definition do not recognise the humanity of individuals, only the coactive identity of groups and are therefore first order.

As stage-3 concludes, each team member has an understanding of other team members. Each individual understands the views, opinions and issues important to others. Each can envisage the situation through the lenses of others and appreciate their point of view, without necessarily agreeing with it. While stage-2 forms the team, stage-3 bonds the individual members together, into a functional team for dealing with the task in hand. Interpersonal problems are in the past, the present is devoted to developing solutions (Tuckman, 1965; Erikson, 1950; Fromm, 1941). Nevertheless, a successful conclusion to

stage-3 is not guaranteed. Several factors can stifle the development of understanding of others. During the storming phase, disagreements and power struggles can become so intense; some team members withdraw and take little part in the development of understanding. If this situation persists, or some faction comes to dominate the team then understanding of others fails to develop. In this situation, there is no alternative but to disband, return to stage-2 and reform the team with a different set of individuals.

5.2.4 Stage 4: Analyse multiple perspectives; to outline themes; define system boundaries.

Entering stage-4, the team will have identified their differing worldviews of the issues and systems under investigation. They will have evolved the 'I-Thou' relationship of trust and mutual understanding that is second order. During stage-4, analysis of assumptions and beliefs that underlie the differing views is undertaken. The aim of the analysis is to develop a set of themes, common or acceptable to the differing worldviews that allows the development of the environment, required to meet the goals of the project. Additionally, the establishment of system boundaries enables the extent of those actions to be identified.

Analysis of these multiple perspectives, allows the surfacing of underlying themes, system purpose and systemic boundaries. The positioning of these boundaries is critical to the system. Thus, the constructed boundaries will define the understanding and extent of the system. If we examine these boundaries, we can in the words of von Foerster (1984), as first and second order boundaries. The first order boundary looks out from inside the system, towards the world, seeing only data and hardware, ignoring people. 'The first order boundary contains the facts and figures of the system'. This in most instances is an easily drawn boundary, becoming obvious once the main themes of the concern surfaces, (Midgley, 2000). The second order boundary looks into the system, from the outside, being dependent on the individuals view, is far more difficult to agree in a group situation.

Containing qualitative data, this complex boundary remains the preserve of the individual or team, (Leydesdorff, 1963). The second order boundary influences the views of reality with the inclusion of people and their perceptions. Second ordered boundaries encompass people, their interactions and the generation of knowledge within the system. The placement of the boundary reflects the extent and complexity of the system and thus the number of individuals included. As the second order boundary extends outwards, complexity increases. Churchman (1970) discussing system boundaries, maintains the boundary must be set to sweep in as much understanding as possible, thus, creating a rich and complex picture of the system. On the other hand, Ulrich (1983), points out the purpose of the systems analysis will impose limits to the possible placement of the boundary. Nevertheless, an agreement of the positions of the boundaries is required for progress to continue. Dialogue, the exchanging of views, the exploration of differing perceptions and worldviews, is the medium used to build an understanding of the system of concern its boundaries and the people affected within those boundaries.

Stage-4 generates systems thinking, even if the team does not realise it, enabling the team to look holistically at the issue of a system. Stage-4, consciously or sub consciously, creates a systems thinking environment. While for second order model use, the team is not required to understand system-thinking theory, some insight would be desirable. For instance while defining the system and its boundaries Checkland's (1981) 'CATWOE' mnemonic, will identify the main elements and participants. In essence, the team working at stage-4, will have identified, 'Customers, Actors, Transformation, Weltanschauung (world view), Owners and the Environmental aspects' as defined by the 'CATWOE' mnemonic irrespective of whether or not the team uses or knows of the terms. These elements and participants, as the literature review makes clear, emanate from 'Soft Systems Methodology', one of the tools frequently used in system thinking action research.

At the conclusion of stage-4, the team will have identified the purpose and boundaries of the system of concern. They should have an understanding of other team members, their opinions, beliefs and prejudices. The requirement is that, a holistic understanding of the system or systems actively contributing to the issue has emerged from the deliberations of the stage. However, management in their role as 'CATWOE' system owners, are in a position to cancel or amend the aims of the transformation process identified by the improvement team.

5.2.5 Stage 5: Initiate dialogue around emerging themes; gain a wider understanding of mental models.

Up to this point, the team has not attempted to consult the individuals within the system identified in stage-4. The understanding between the team is termed intra-understanding meaning 'internal to the team'. Additionally to assume, the team will contain the requisite variety to be able to envisage all possibilities, is incorrect. It would also be incorrect to assume, the affected individuals within the defined system, who are external to the team will share the team understanding.

Therefore, the team must extend understanding, to those affected by the change; this is termed inter-understanding, meaning the 'teams understanding has spread outwards into the world of the system'.

To develop wider inter-understanding, the team must communicate the results of previous stages to the people affected. Developing a feed back loop with system members', stage-5 can use numerous means of transmitting and receiving information. In cases where only a small number of people require consultation, this process is relatively simple, one to one meetings with team members may be used. However, similar to system boundaries, as the number of individuals increases so does the complexity of the feedback process. One to one meetings become impossible and methods such as questionnaires and focus groups

need to be utilised. Whatever mechanism is adopted to develop two-way communication, the aim of stage-5, is to involve as many of the affected individuals as possible.

As the team involves more individuals, there will be new opinions and assumptions, these will have an influence on the intra-understanding of the team. As intra-understanding evolves into inter-understanding, a deeper awareness and understanding develops within the team, while simultaneously extending that understanding to the people affected by the possible improvement changes.

At the conclusion of stage-5, the team has extended intra to inter-understanding, an understanding shared with the individuals included within the system boundary. The initial stage-4 intra-understanding of the team will have undergone revision in the light of the external information, ideas and opinions becoming available during stage-5. If this is the case, the team may find it necessary to reiterate earlier stages, revaluating earlier assumptions and definitions of system purpose and boundaries. Stage-5 generated external feedback of, facts, figures, ideas, assumptions and opinions, are used to revaluate understandings from stages 3 and 4. As Churchman (1970) requires, stage-5 serves to deepen understanding and creates a wide rich picture of the system and situation of concern. However, as Ulrich (1983) correctly points out, this iteration of stages 3, 4 and 5 must have a conclusion. Therefore, the team must achieve an objective balance. The objective being the development of a clear collectively agreed understanding, supplying as rich and detailed a picture of the situation as possible while, at the same time, ensuring that the picture is not clouded with items that are not pertinent to the investigation.

5.2.6 Stage 6: Co-create meaning and evolve the language addressing the situation of concern.

At the beginning of stage-6, more individuals will be included in the improvement initiative. To ensure maintenance of joint understanding, a language of the system is required. A language used and understood by all, where each individual understands the meaning of the terminology used by others.

Systems thinking provided a generic systems language, a language that has a subtle but influential effect on the way we view the world. This language is a way of communicating the complexities and interdependencies. The language of systems thinking is circular rather than linear. Focusing on closed interdependencies' between the elements, where alterations to element A, will affect element B, in turn affecting element C, eventually in turn have an effect on element A.

System thinking provides a set of tools such as; causal loops, structural diagrams and behaviour over time diagrams, which have a strong visual component. Complexities can be clarified, allowing identification of the key elements. The diagrams of systems language can be powerful means for fostering a collective understanding of a problem. Once individuals have stated their understanding of the problem, they can collaborate on addressing the challenges it poses, (Cooper 1989; Fishman 1991; Sterman, 2000; Williams, 1992). Irrespective of whether the generic system language tools are used or not, the team and other affected individuals require a common language to describe the system: its attributes and purpose. An organisation has many languages; normally aligned with departments, the language of Accounts, Sales, Engineering, and Production all have their own terminologies. Still, in order to communicate about a given system between departments effectively, a language specific to that system is required. A language

developed to meet the needs of the situation, agreed and used by all. While this may seem an obvious requirement, differing departments often refer to the same phenomena in differing terms. For example the technical department spoke of a problem as a "*medium static leak'* while in the assembly area this was termed a '*creep'*. While this is a simple example, it demonstrates that even within the same organisation, departmental languages exist using differing terminology for the same phenomenon that can cause confusion and misunderstanding.

Stage-6 has the purpose of developing the language of the system under investigation. The team in conjunction with others must define the terminology used and champion its use when communicating with those involved. This can prove problematic, as illustrated in the '*medium static leak or creep'* example, where differing departments refer to the same phenomenon in differing way. One or both departments will be required to alter what is to its members' is 'everyday language'. However, it is just such examples that highlight confusion and misunderstanding. A common language alleviates such problems and allows interdepartmental communication. Second order develops, the understanding required in such cases. To be in a position to say *medium 'static leak and creep'* both refer to the same phenomenon, what terminology are we as an organisation going to use? The answer to this question may be to use one or other term or perhaps if the terms are indeed part of differing departmental language use both in the understanding that they refer to the same physical phenomena.

At the conclusion of stage-6, the team will have developed a systems language that is agreeable to all the actors affected. A language used by all, as a matter of course in communicating with one another. This defined language, has eliminated problems through clarification of meaning and agreeing the purpose and boundaries of the system of interest.

In so doing, stage-6 causes communication of meaning, worldviews and understanding to become part of everyday language used within organisation.

5.2.7 Stage 7: Facilitate emergence of infrastructure to improve the situation.

As stage-7 commences, the system has been defined, purpose and boundaries clarified, and a systems language developed. Second order understanding has been established, a set of important themes and a common objective agreed with the actors. However, the actions required to perform the 'CATWOE' transformation is still to be addressed; it is at this stage that management involvement becomes essential. Up until stage-7, the team could function almost independently of management, as long as the team has managerial support and backing, with information, time and other resources during the investigative stages. However, stage-7 inaugurates change, and in so doing will alter internal organisational systems. Additionally the teams' investigations and developed understanding, could as will be seen in a later case study, require strategic decisions from senior management. The teams' understanding of the issues will enable identification of number alternatives, but the final decision of which alternative to adopt is the responsibility of the senior management team.

In the implementation of agreed system change, it is possible to adopt several methods. The method adopted, will be dependent upon the organisational structure and nature of the change proposed. The timescale of change will be a contributing factor, as will the extent of the change. Questions will need to be addresses: will the proposed system change require a short period of one or two days or at the other extreme several years? What will be the effect of change, are they reversible or irreversible once implemented? For example, a change of supplier as opposed to relocating buildings. Stage-7, examines these and other issues to bring about the infrastructure of change; identifying the people affected, deploying the resources of labour, materials and money required, the time scale and most

importantly the consequences of that change. The understanding of the situation developed by second order understanding allows identification of these factors, with a high degree of confidence. In developing the infrastructure for change, it is important to consider the vertical and horizontal dimensions of implementation. Organisations have vertical (hierarchical) and horizontal (interdepartmental) dimensions. Whatever the implementation method selected for the enactment of change, both vertical and horizontal dimensions are important to success.

One method of change implementation used in development of the second order process was the deep slice approach as described by Professor David Weir during a workshop conducted at Northumberland Manufacturing and shown in Table 4. While not suitable for all situations, it did prove successful as a means of implementing change at Northumberland Manufacturing.

Table 4, Deep Slice Departmental and Interdepartmental Infrastructure

Department A	Department B	Department C	Department D
Departmental Head	Departmental Head	Departmental Head	Departmental Head
Supervisor	Supervisor	Supervisor	Supervisor
Specialist	Specialist	Specialist	Specialist
Action Implementers	Action Implementers	Action Implementers	Action Implementers

The deep slice approach has both the vertical and horizontal dimensions required. Vertically, each team has members from all levels of the department, championed by the departmental head. This departmental championship gives senior management backing and departmental support. Each department supplies an individual to take ownership of departmental activities and supervises actions required from his or her department. In the absence of the departmental manager, this individual acts in the senior manager's name as the departmental champion. Similarly, a specialist and a number of action implementers,

who actually carry out the transformational actions come from each department. Thus, a sub team from each department implements the actions required to enable the agreed organisational system change.

The horizontal team consists of one member at similar organisational level from each department involved in the transformation. The horizontal element brings the interdepartmental communication and exchange of ideas and opinions required to maintain second order understanding and interdepartmental harmony. Together, the vertical and horizontal components of the deep slice approach maintain the second order approach of sharing and cross communication between individuals, groups and departments.

Whichever method is utilised the aim of stage-7 is to create the infrastructure enabling the enactment of system transformation. In short, the function of stage-7 is not to carry out the transformation, but to create the conditions that make the transformation possible. Once implementation commences, the team monitors the affected system, checking that it is reacting in the manner expected.

5.3 SUMMARY

In this chapter, the second order process was described. It is based on understanding others' understanding through dialogue. It consists of seven stages of enquiry: listening for situations of concern, creating a voluntary team, exploring perspectives of the situation of enquiry, the analysis of perspectives, initiating wider dialogue, co-creating meaning and shared language and facilitating infrastructure of change. The context of the situation will dictate the order in which the stages will be used.

The next chapter explores the use of the process in two case studies

6 CHAPTER 6: PROCESS CASE STUDIES

This chapter contains two case study examples showing the application of the second order process. Reflecting stage by stage on the strengths and weaknesses, the selected studies show the versatility of the process, the two cases represent various aspects of the application of the process.

The first is the development of a time and attendance system. This case demonstrates the ability of the process to deal with issues that have a large social dimension. The social aspects of the issue could have proven extremely problematic, possibly causing lasting damage to management-employee relations. The use of the process in this context, allowed the development of a system that had input from the largest possible number of organisational members. Consequently, the workforce accepted the time and attendance system, without any deterioration to management-employee relations.

The second case of the Lung Demand Valve is one that contained both statistical and social issues. Checkland (1981) would have described this as a messy problem. The root causes were unknown and the extent of those effected could initially only be estimated. The issue had the potential to result in reduced customer confidence in the product. As the end user of the product relies on it in life threatening situations customer confidence in the reliability of the lung demand valve is critical. This case clearly demonstrated that the process could be applied to issues that require statistical analysis as well as social analysis. These two studies were selected to demonstrate the processes suitability in situations requiring differing approaches.

6.1 TIME AND ATTENDANCE SYSTEM

6.1.1 Introduction: The Situation of Concern

Traditionally individuals were not required to signify their attendance through a formalised 'Time and Attendance System'. The norm was not to record arrival times or attendance, relying on a trust based word of mouth system, with sickness reported by the staff members via telephone. Days taken as holiday were agreed between each staff member and his or her immediate supervisor. Once agreed, a holiday sheet showing the days taken and, any remaining holiday entitlement was forwarded to the receptionist who kept a duplicate copy. This system worked well and gave the staff a sense that the management had trust in them not to abuse the system. It also had the advantage to the organisation that technical and engineering staff willingly stayed behind after normal working hours, or came into work early when required without extra payment. However, the traditional system had no process of accurately recording the number of hours worked by any individual. This situation became unacceptable and required amendment, when the European Union issued a new working time directive, requiring the recording of accurate working hours for all staff members. These records had to be available for inspection on request, and the organisation becomes responsible to ensure that no individual works more that an average of 48 hours over a rolling 17-week period. Obviously, the system based on word of mouth and trust with no recorded working hours was unable to fulfil these requirements. The following case study follows the development of a time and attendance system to rectify this situation.

6.1.2 Stage 1: Listen For Situations of Concern or Improvement Opportunities.

In late 2003, the Human Resources department became aware of the impending update to the 'European Working Time Directive'. On examination of the proposals, it became obvious to the Human Resources Manager that the trust based unrecorded system for individual staff members' working hours was unable to meet the proposed new

requirements. The proposed alterations required the company to have processes in place, to ensure individuals did not work more than an average of 48 hours, over a rolling 17-week period. Additionally, records of the working hours of each staff member were to be available for inspection on request. Failure to comply with the new requirements could result in the imposition of heavy financial penalties on the company.

Having realised that the then current trust based, unrecorded attendance system required substantial amendment in order to comply with the proposals; the Human Resources Manager took his findings to the Board of Directors. While the board appreciated that the situation required attention and eventual amendment, all agreed that handled with insensitivity the amendment process could destroy the organisational benefits delivered by the existing system. Initial investigation found that software systems existed that would comply with the requirements; all required staff to record their arrival and departure. In essence, in order to comply, the company needed to introduce what most people would term 'a clocking in system'. This posed a dilemma to Senior Management. The hardware and software required to implement such a system was readily available from a number of sources and therefore, did not pose a problem. However, the implementation of such a system certainly posed a social dimension that could lead to a problem with staff relations. The question facing management was simply, how to implement a system without causing ill feeling within the workforce? Management faced the choice of unilaterally enforcing a system, or requesting staff involvement in the development of a system that would have the co-operation of the workforce. The management decision was to use the second order improvement process, as a means of enlisting the assistance of the workforce in the development and implementation of a system. Therefore, management requested this researcher, to act as a process facilitator to guide an improvement team in the stages of the second order process. The management having made the decision, requested the Human Resources Manager to circulate an email to all staff members informing them that due to

amendments in the 'Working Time Directive' unfortunately, it was now necessary to implement a formal 'Time and Attendance System'. However, emphasising that the senior management team did not wish to impose a system on the workforce, he invited individuals to volunteer to form an improvement team to investigate alternatives and develop the required system. Following a number of replies to his email, he convened a meeting of those interested. At that initial meeting, he gave a brief explanation of his thoughts on the proposed alterations to the 'Working Time Directive', and indicated that in the view of senior management, a 'Time and Attendance System' was required. He also indicated that the management thought that 'the second order improvement process' could be used by an organisational improvement team, to develop a system, thereby enabling the workforce to have an input into the development and implementation of a system. A system he felt sure no one really wanted. However, along with confirmation of the use of the second order process as the method adopted for the development, the form and operation of the system was to be a team decision. The selection of equipment and development of operational process was also to be a team decision, the only stipulation being that it must meet the newly proposed directive requirements.

While stage one of the processes requires, that the individual making the suggestion should lead the team in this case, the Human Resources Manager, he declined the position Instead suggesting, one of the volunteers from the personnel department take up the role. Those present accepted this suggestion. The HR manager also pointed out that as there already was a door entry system in operation throughout the plant, the suppliers of that system may be able to provide a system based on the equipment currently installed.

Following a decision to proceed with the improvement process, stage-1 requires the consideration of the rough formation of the team. During these deliberations, it became apparent that external expertise would be required in order to provide information on the

alternative clocking in systems available. Therefore, the team requested a member of the door entry hardware and software supplier became a member of the team, as a consulting expert.

Considering the primary purpose of stage-1 in the process is, 'identification of a problem or possible improvement opportunity by company personnel', the 'Time and Attendance System' meets this criterion. In this case, the individual identifying the problem was a member of the senior management team. Nothing precludes this situation, as the senior managers are both members of the company and in a position to identify problems and improvements. Nevertheless, having identified the problem situation, during discussions with his colleagues, they recognised the social aspects of what at first impression appeared a simply remedial situation. Therefore, the board took the decision to utilise the second order process and invite volunteers to develop the system and thus defuse the social problems of the required clocking in system. However, a member of the management team making a suggestion and leading a second order team would cause difficulties. With this in mind, the Human Resources Manager initiated the formation of an improvement team, gave a broad outline of the objectives and then, as already mentioned, excused himself from further team deliberations.

To some, this approach from the Board of Directors may have seemed, as cynically transferring responsibility to an improvement team. While the alternative view would be that, the decision empowered staff to take ownership of the situation and evolve a solution acceptable to the majority. Irrespective of the view taken, the decision to use the second order process to develop a solution to this problem was made in answer to the social aspects of the situation.

6.1.3 Stage 2: Create Volunteer Research Team from Interested People.

In this case, stage-1 moved into stage-2 almost immediately following the initial Human Resources Manager arranged meeting. The email respondents invited to participate in the team represented a cross section of the workforce from all the major departments, including, Human Resources, Accounts, Customer Service, IT services and Production Processes. This meant, the team was cross-functional and reflected all the departments within the organisation. While some members of the team had worked together in the past, the majority had not nevertheless, the team were willing to work together and open their minds to the ideas of others. The initial responsibility of this researcher, in the role of facilitator in the use of the second order process, was to outline the thinking and underlying principles of the process. After some discussion, the team came to the decision they wished to use the process, additionally they felt the process was suited to the development of a solution to the social problem at hand. The consensus with the team was that the various stages would allow the inclusion of the maximum number of opinions, thereby creating the widest possible combined worldview. The underlying principles of the process of change, through understanding and agreement, are the specific attributes required to gain acceptance of any new system by the workforce.

Following the advice from the member of the IT department the team concluded, that knowledge of the hardware and software required for such a system was not available within the organisation. For this reason, the team had requested a representative from the supplier of the existing door entry system to attend a number of meetings to discuss the alternatives available. The supplier was more than happy to comply with the request supplying a representative for as long as required. Thus, the second order improvement team came into existence. The team members were volunteers willing to work together and follow second order understanding principles. They possessed the requisite variety to reflect the interests of the organisational departments and had the knowledge of the options

available from an external source. Stage-2 concluded with a group of people comfortable in each other's company, able to express their thoughts freely and willing to allow this researcher to guide them in the use of the second order process. The group also had the backing and support of the senior management team who had given the team full authority to select the hardware and software but more importantly, define how that hardware and software was to be utilised in order to comply with the proposed requirements of the updated 'Working Time Directive'.

6.1.4 Stage 3: Explore differing Understandings and Worldviews.

Stage-3 began with a meeting to come to a deeper understanding of the requirements of the updated Working Time Directive. To gain an initial understanding, the team requested the Human Resources Manager attend the next meeting and give his latest interpretation of the current requirements and the proposed new requirements. He explained the directive had one main condition that affected the company. This presently stipulated that the company could not require any individual to work in excess of 48 hours per week. However, if an individual agreed in writing he or she could work in excess of the 48 hours. He also indicated that an organisation could not require compulsory Sunday working but this was a condition directed more at the retail rather than the manufacturing sector. He informed the team of this rule only to give an overview of the regulations.

Turning to the proposed changes, he made it clear that at that point in time they were 'simply proposed changes'. However, in his opinion the implementation of the proposals was most probable, at which time the new requirements would become compulsory. The proposals affected the organisation in two ways. The first covered the agreement between an individual and the organisation not to work in excess of 48 hours per week. This option would no longer exist; employees could not exceed the 48 weekly hour's average, unless the organisation was in an exempt sector, such as hospitals. More importantly if

implemented the proposed directive, would require the company to have a process of recording and reporting on the hours worked by each individual. This alteration required the development of a 'Time and Attendance System'. Concluding his explanation of the proposals, he indicated further sources of information the team may wish to explore.

Following the meeting with the Human Resources Manager, the team returned to their respective department to conduct their own research and consult colleagues. Coming together, the team began to explore and share their personal views of the management's reason for the introduction of the system. Some individuals expressed the opinion that management seemed extremely enthusiastic to introduce a system when the proposals may never actually become compulsory. Additionally, the cost of the system was not a consideration which was unusual, as cost normally played a predominate role in the introduction of new equipment. The joint conclusion being that in all likelihood, the management was using the proposed changes as a means of introducing a system irrespective of the possibility that it would not be actually required. However, the team's joint view was that management intended to introduce a new system, and the team's function should be to develop a system acceptable to the workforce in general, changing the current practices as little as possible. The alternative being, to return to the Human Resources Manager, to inform him the team did not see the requirement for a Time and Attendance System. While this was an alternative, the team concluded that the management would then impose a system on the workforce without further consultation. This understanding developed using dialogue and exchange of personal member's views concerning, the management's apparent enthusiasm and money is no object attitude. A management-imposed system was not an acceptable outcome for the team. The decision was to continue with system development; irrespective of the team's opinion of management's underlying motives for the introduction of a clocking in system.

To conclude stage-3 and form a transition into stage-4, the team invited the representative of the present door entry system to attend a meeting and discuss the possible alternative system configurations available from her organisation. This would also allow the team to come to a decision to, ether continuing with the current supplier or asking other suppliers to provide suitable alternatives. Acting in the capacity of a system consultant, the representative from the software and hardware supplier first considered the existing door entry system. Explaining, the system installed was some ten years old and used outdated technology, she made the point that it was not a practical proposition to update that system to accommodate the present requirements. The remainder of the meeting consisted of a discussion between the supplier representative and the other members of the team covering the team's views on the minimum system requirements. The supplier's representative then gave brief details of the possible alternatives, ranging from a combination of a simple door entry system and a basic clocking in system, through to sophisticated combined employee tracking systems. She concluded with an offer to demonstrate the various options at the following meeting, and arrange for the team to visit an organisation using one of her company's systems. The team agreed to this and thanked her for her time and contribution. Thus, stage-3 ended with an agreement that the demonstration of possible alternatives becoming the first analysis for stage-4. The team had a clear view of the minimum system requirements. However, they also appreciated systems existed that would make other processes available, that were not required by a system developed solely to cover the proposed updated directive requirements. However, the agreement from stage-2 to change the current processes as little as possible remained the underlying objective.

Stage-3 performed the function, of exploring the worldviews of the individual team members. Using a dialogical approach, each member gave their opinion and thereby allowed the differing views to surface; however, little disagreement existed regarding

management's motives. The stage spanned several meetings and this researcher, acting in the role of process facilitator, was able to steer the team through the sharing of worldviews and the use of dialogue to reach agreement. The team eventually, became willing to exchange ideas and request one another to explain the thinking behind their assumptions. As the meetings progressed, individuals began to examine the issues, not only from their own perspectives, but also from the perspective of others. In this case, stage-3 proved, a successful method of bringing a number of individual views to the surface, thereby enabling understanding between individuals to develop. The drawback to using the second order process was the time required to explore the differing understandings of the individuals. Agreements and understandings arrived at through dialogue take time. The stage requires team members to exchange views, and come to agreements that each member of the group considered acceptable. However, acceptable does not mean all the team was in total agreement, only that the derived joint agreement was something all the team could accept. This can be a lengthy process, and the consideration of one individual's opinions, while suspending your own, is difficult to master. In this case, the team came to the common understanding that management's motives were questionable but that it was in the interest of not only of themselves, but also the workforce in general to continue with the teams development and the introduction of the 'Time and Attendance System'. Nevertheless, the consensus was to introduce as few changes to existing practices as possible. Thus, stage-3 came to this conclusion, reached through exploring and understanding the worldviews of individuals by others.

The diagram shown as Figure 7 below gives a pictorial view of the exploration of various worldviews conducted within stage-3 by the team.

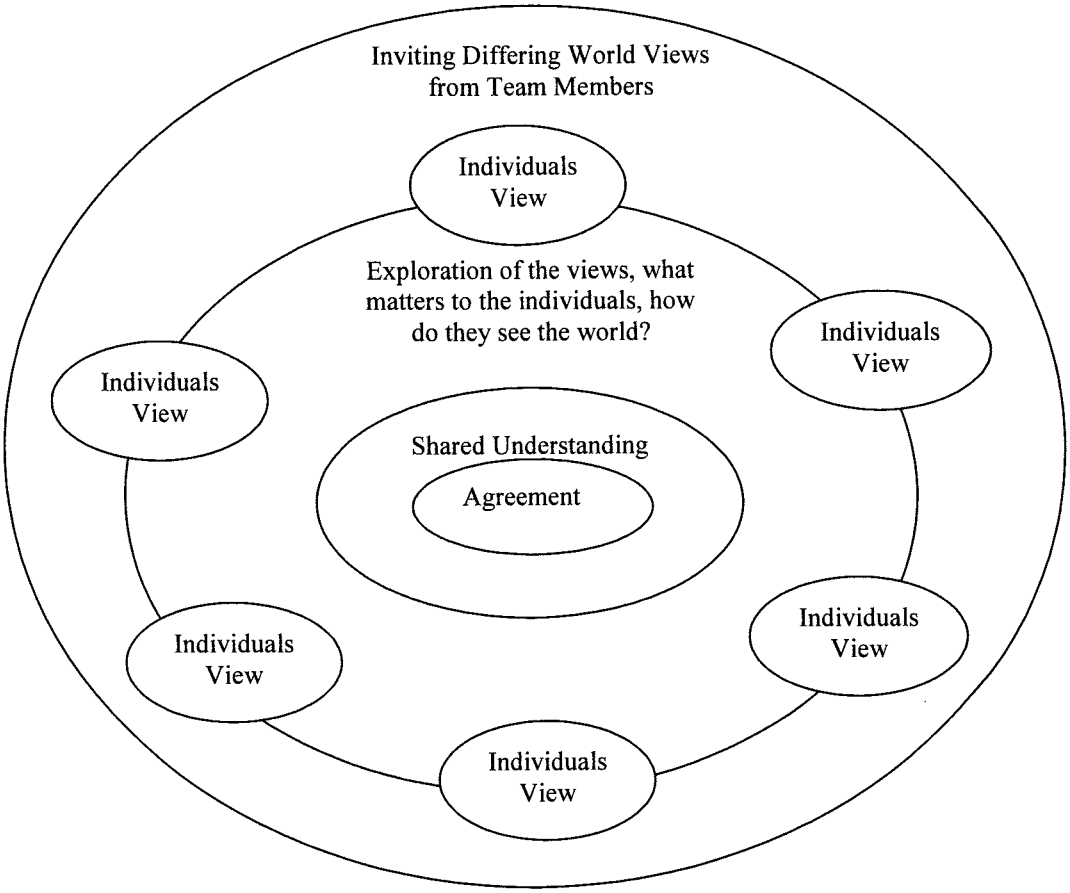

Figure 7, Exploration of worldviews leading to team agreement

During the exploration of stage-3, views emerge during the dialogical exchange of ideas. However, the process facilitator has to ensure that team members consider the views of each other, and occasionally remind them of the second order nature of dialogue; where no one view, is considered superior to another, just different. The explorations of team member's worldviews, lead to a joint understanding of other team members understanding. Once such an understanding exists, it becomes possible to reach an agreement that took account of the various worldviews and opinions. Thereby, accommodating all the team

members in an agreement some may prefer more than others but an agreement all can agree and carry forward to stage-4.

6.1.5 Stage4: Analyse Multiple Perspectives to Outline Themes; Define System Boundaries.

Stage-4, commenced with, as the software and hardware supplier representative had promised, detailing the three suitable possibilities offered by her company. These included, the simplest and least expensive: an updated door entry system with an additional basic 'Time and Attendance System'. This option would require the use of one card for the door entry system, and another for 'Time and Attendance' system. The second possibility again entailed two systems, a 'Door Entry' and 'Time and Attendance' system. However, the software for these separate systems was capable of using a single card, thus, only one card would be required and therefore, the two systems be seen as single system by the workforce. The third alternative and most expensive concluded the system possibilities: an individual tracking system that monitored the movements of individuals from room to room or building to building.

The alternative forms of staff member recognition came under discussion; they consisted of, swipe cards, proximity cards and proximity key fobs. These again had increasing initial cost. However, the proximity cards and key fobs were easier to use. The combination of systems and cards became the subject of later discussions. The team then visited an organisation using the tracking version of the system. The organisation was a large firm of solicitors, based in two buildings several miles apart. The system linked these two buildings; administrators were able to pinpoint the location of partners' associates and employees. The system administrator, answered questions from the team who arrived at the following understanding. The system tracked the movement of individuals between the two buildings. However, this had taken some time to develop, as individuals especially partners in the company forgot, or initially were unwilling to indicate leaving one building when travelling to the other. Following several memos and meetings, people began to

operate the system as intended. From that time, the system had operated without problem and people now utilised the system automatically. However, people still occasionally forget to indicate arrival or departure from the buildings.

Having come to an understanding of the alternatives available the team, including the supplier representative, acting in the capacity of a consultant and this researcher as second order process facilitator, discussed how each system fitted the needs of both the organisation and individual staff members. The two-card system, was quickly discounted because to the inconvenience to staff of having to use two cards. This left the 'two system one card' and 'fully integrated system' as the remaining available choices. Both alternatives of the 'Time and Attendance' components were capable of accommodating the various shifts and working patterns within the organisation. Discussing the strengths of the respective systems the team concluded that while the 'two card system' was suited to the needs of the company, the fully integrated system had the benefit of being able to track the movements of individuals. The supplier representative pointed out that while this was not a requirement, it did allow the generation of the location of individuals in emergencies. Still, the team had reservations with utilisation of the system to provided listings of the individuals within the buildings on site. Additionally, this would be an unnecessary change, as it was not required to cover the proposed regulations and therefore was not acceptable to the team. Nonetheless, to explore the concept of the usability of such a system in emergencies, the safety officer was requested to give his views on the subject. He confirmed the opinion of the team that the listings would be inaccurate, agreeing that people would not indicate their leaving one building and entering another on all occasions and thus undermining the accuracy required for emergency use. A significant proportion of employees moved frequently between buildings, any one of these individuals could enter or exit a building in a group omitting to register their movement from one building to another. Therefore, the team's decision was to select the 'two system one card' alternative.

This selection gave the required functionality, with the minimum of alteration to existing practices.

Turning to the method of staff member identification, the team rejected the swipe card in favour of the proximity versions. The group understanding was that the proximity systems were less time consuming, when several people wanted to use the system at the end of the day. The choice of card or key fob offered the same timesavings. However, one advantage of the card was that the individuals photograph, name and department could be printed and displayed. Thus, the proximity card became the favoured option.

The team having analysed the system possibilities, considered the perspectives of the various individuals and aspects of safety listing, along with the time implications of the various swipe and proximity identification system, were in a position to begin identification of system boundaries. The team had come to an agreement on the software that would provide the functionality required to comply with the proposed updated 'Working Time Directive'. At this point, the team took the time to examine basic systems theory, and allowed this researcher to guide them in the placement of the first and second order system boundaries.

First order system boundaries, encompass the physicality and information regarding that physicality. In the case of the 'Time and Attendances system, the hardware, software, wiring, entry and exit units, their location, and the proximity cards that would be used by individuals etc. The team had decided the system software along with the proximity cards required.. However, they still needed to consider the number and location of door entry and clocking station locations. An initial thought from the accounts representative was to minimise cost by restricting entry and exits to main doors. This would mean that the remaining doors becoming fire escapes, incapable of opening from the outside. However,

the IT representative put forward a valid reason for not following this suggestion. Pointing out that IT technicians moved computer equipment around the site, and that being restricted to main door use would seriously hinder their ability to move equipment easily or efficiently. Additionally, this would be an unnecessary change to present practice and would negate the agreement to minimise change. Thus, the first order boundary of the system covered all the doors presently used in the door entry system. Computer hardware requirements were a standard PC, acting as the system server and the report generation software loaded on the machines of the departmental managers' personal assistants. Thus, the team identified the first order boundary as the computer hardware and software, the physical locations of that door entry points, along with the preferred swipe cards.

The second order boundary is concerned with individuals: their opinions, beliefs and the effects system change will have on those individuals. Therefore, the identification of those individuals is a qualitative judgment, of the people defining the boundary. While ideally all individuals or groups possibly affected by system change should be included, unfortunately this is not always possible. In some instances, the number of people possibly affected prohibits this approach, thus, it becomes necessary to select a smaller number of individuals who are representative of the overall group. However, in this case this boundary encompassed every individual working for the company. While socially difficult, the boundary was easily established. Every member of staff would be required to use the system thus; the second order boundary encompassed the entire workforce.

This point marked the completion of the requirements of stage 4, the team had arrived at the specification of the software and defined the first and second order boundaries of the system they had agreed the number and location of the door entry and clocking in units. The challenge now was to convince the wider workforce of the need for the system.

During stage-4, the team had considered several alternatives, they were guided in the use of dialogue to exchange knowledge of their departments needs and working practices, initial ideas became modified to accommodate the needs of others. Second order understanding became established in the team's deliberations, with members treating each other as equals, whose opinions were important and of value. The drawback to the process was the time required by the team to explore the alternatives and jointly agree the way forward. Some systems theory was required in order to understand first and second order boundaries. However, the advantages of considering in depth, the multiple perspectives of the individual team members and the alternative solutions outweighed the time disadvantage. Team dynamics played a defining role in this instance. At this stage, team members had put forward suggestions and opinions. Each suggestion was explored in detail to understand the implication of acceptance. Several suggestions were after discussion rejected, however, this was with the agreement of the individual who first made the suggestion. Acting as the facilitator it became the responsibility of this researcher to encourage dialogue and the exploration of possibilities within stage-4. This action accomplished with the agreement and cooperation of the team, made the understanding and agreements arrived at possible.

6.1.6 Stage 5: Initiate Dialogue around Emergent Themes; Gain a Wider Understanding of Mental Models.

Stage-5 has the daunting task of extending the understanding evolved by the improvement team, out into the wider systems world of the system under review. This in essence means that stage-5, has the purpose of communicating the understanding of the team to the individuals included within the systems second order boundary. In the case of the Time and Attendance System, the second order boundary encompassed the entire workforce, which at that point in time consisted of approximately 370 individuals. However, the team also realised that stage-5, was the heart of the social dimension of the situation. Failure of

stage-5, in not communicating understanding would mean the failure of the successful introduction and acceptance of the system. With this number of individuals affected, the ideal one to one method of communication was impractical. All the same, a method was required that would allow each member of the workforce to put his or her point of view forward if they wished. The second order process, considers no individuals view without merit and no view superior to another. Therefore, in order to follow the process a method of communication had to be established.

As a first step, the team agreed to inform the Human Resources Manager, through the HR representative, of the selected hardware and software configurations and invite him to convey this to the senior management for their opinions. This he did, and returned the management's joint opinion that the selection made by the team would provide a means of fulfilling the need to record individuals working hours and in so doing meet the requirement set for the team. Therefore, the management had no objections to the teams' selection and reiterated their support and backing. However, the management team were only a fraction of the workforce affected. Therefore, the team after some discussion concluded, that multiple methods of communication with the workforce would be required to ensure that as Churchman (1970) advises, *"sweep in as much understanding as possible thus creating a rich and complex picture*" of the varied views of those that would eventually use the system. In order to do this, three main methods were used, firstly an explanatory memo issued to all employees. Secondly, a questionnaire of open questions that allowed the respondents to give opinions and ask written questions, if they wished. Thirdly, informal conversations, with individuals or groups in non-formal settings, such conversations have been termed '*water cooler conversations'* in the literature. These three forms, in combination with feedback to the general workforce of answers to questions received by the team, provided a two-way exchange of opinions and ideas. In this way, matters arising from wider discussion and widening understanding of the worldviews and

opinion of the staff were used to modify earlier joint understandings reached by the improvement team. Having decided what form the communication would take, the question of how to distribute the memo and questionnaire had to be agreed. Several approaches were suggested these ranged from a general hand out during the weekly briefing session to a separate distribution to all individuals in the internal mail. However, while these methods would ensure communication with a majority of staff, none would guarantee the entire workforce would be included, as one team member pointed out some staff may be on holiday or on sick leave at the time of the brief or hand out. In answer to this dilemma, the HR representative came up with the suggestion that attaching the memo and questionnaire to salary slips would ensure all employees even those on long-term sick leave would receive them. To make sure as many employees as possible were made aware of the impending distribution of the documents an announcement was made during the two weekly briefing sessions preceding the issue of the questionnaire. Having decided the forms of communication, thought turned to the information supplied on the explanatory memo and the questions on the questionnaire.

The decision with regard to the memo was to supply the workforce with a description of how the system would be used on a day-to-day basis. For example, placing a proximity card close to a clocking in station will cause the system to identify the individual and log the arrival or departure time to his or her time record. An audible beep would sound, and the proximity unit will display the name of the person. Additionally, a short description of the changes to the 'Working Time Directive' requiring the development of the system was supplied. The memo also contained information with regard to the questionnaire. The questionnaire contained four questions requesting the opinion of the respondents. These questions can be seen in Table 5.

Table 5, The Workforce Time and Attendance Questionnaire

Please answer the following questions. Answers will be anonymous and questions passed to senior management in the name of the improvement team.
1) Have you ever worked in an organisation that used a 'Time and Attendance System' (Clocking in system)?
2) Do you object to the use of a 'Time and Attendance System'?
3) Please give your opinion on the introduction of a 'Time and Attendance System'?
4) Please list any questions you would like the team to put to senior management on your behalf?

Following the distribution of the questionnaires, a box, similar to a ballot box, placed in the works canteen for a week, allowed the workforce to return them anonymously. Having analysed the returned questionnaires, the team formulated a list of questions passed to management, on behalf of the workforce. These questions included the following:

1. Can the system be used for flexi time working?
2. What happens if someone forgets to clock in or out?
3. What happens if someone forgets his or her card?
4. What happens if a person loses his or her card?
5. Will the records be available to individuals?
6. Who will have access to the records?
7. How will management use the records?

Having passed on and received answers from the management, the team forwarded the answers to the workforce again attached to staff salary slips. Management like the team understood that the answers to the questions would act as the tipping point for the proposed system, gaining acceptance or causing rejection. For this reason, the management considered questions concerning discipline and flexi time working with care. Stating, it was not their intention to use the system in a disciplinary manner, and did not discount a flexi working system some time in the future. These and other questions were answered in a positive manner. In the case of the questions related to the general use of the system and

cards, they simply answered that this was for the improvement team to decide when developing day-to-day system operation. Following the distribution of the answers to the questions, the team discussed the situation with their departmental colleagues and others whenever the subject arose. The wider understanding of the system gained by the team and workforce, gave an opportunity for general discussion and the team to re-evaluate their initial thinking. As it turned out, a large proportion of the workforce had worked in organisations operating time and attendance systems. Most individuals had no objection to the introduction of a system, accepting that a Time and Attendance System was required. However, most agreed that involvement of the workforce in the development and implementation was a positive influence on their acceptance of the system.

Thus, stage-5 concluded with the workforce in the main accepting the need for a Time and Attendance System. A first thought might indicate, the perceived social problem in actuality did not exist. However, from the discussions with the wider workforce following the distribution of questionnaire answers, the teams' understanding was that the second order approach, as opposed to a management-imposed system, had made a difference. Had the management imposed the system without consulting the workforce, the workforces' reaction would have been unfavourable. The main direction of comments being, that the stage-5 communications and consultation process allowed the staff to have an input and influence on the operation of the new system.

The team had encountered problems in this stage. The methods of communication, along with the method of distribution took some time to clarify. In addition, issues required addressing such as what questions to ask, and how to collect answers. Acting as facilitator-required patience, this being the most difficult of the stages to this point. The teams' shared vision of the issues and outcomes of this stage made it highly significant to the successful development of the system. Nevertheless, the process allowed the team to

work through the difficulties, sharing opinions and ideas until reaching joint understandings and agreements. Having developed wider understanding and gaining the acceptance of the workforce, the team was ready to move on to stage-6 and develop a language for the system.

6.1.7 Stage 6: Co-create meaning and evolve the Language Addressing the Situation of Concern.

Stage-6 deals with the language used to describe and communicate about the system under review. In the case of the time and attendance system, this entailed the team developing definitions and explanations of the use of such things as clocking in units placed at entrances to buildings, along with the proximity cards used to indicate an individuals arrival and departure from the companies premises'. As these units and cards were new pieces of equipment, this proved an opportunity to develop a common systems language to cover the daily operation of the system. Simultaneously to the creation of the language, the team began to develop system meaning and the processes that would control system operations. As a starting point, the questions of initial card issue to employees came under review. The proximity card serves two purposes, firstly as a means of entry to buildings, and secondly to signify an individuals arrival or departure from site. Achieved via two types of units one externally that unlock the doors, the other an internal unit that records individuals' arrival and departure from site. For the user there is no distinction between the two software systems. This meant that all members of staff required a card before the system could become operational. Additionally for new employees, the supply of a proximity card would be required as soon after commencement of employment as possible, to enable the recording of their worked hours. The team member from the system supplier indicated the possibility of printing individuals' photographs on their card enabling it to be utilised as a name badge. While not necessary, the team decided that for name badge use, photo cards were a good idea and therefore permitted this departure from the change as

little as possible stance they had adopted. This required the purchase of specialist equipment and sessions arranged to photograph staff members. An initial question requiring resolution was, 'who would be responsible for system administration?' The team agreed as this was a Human Resources issue; the HR department should take ownership of the system. However, to spread the daily administration workload, it was decided that an administrator would be allocated for each department. Turning to the question of lost or forgotten cards, the team came to the agreement that individuals, who forgot their card, would report their arrival to their respective system administrator who would manually enter their arrival and departure. Individuals who lost their card would follow the same procedure until replacement of their cards took place. The team also decided that the company would make no charge for the replacement of lost proximity cards. This was the practice for the 'door entry swipe cards' in use at the time. However, as they did not wish to pay the replacement charge, people who lost their door entry card, simply did not have them replaced. This had lead to the door entry system becoming virtually unused and doors left permanently open. Such a situation could not occur with the new system, cards were essential to its operation, and therefore lost cards would require removal from the system and replacement as quickly as possible once the loss was discovered. The team agreed that, as management required the system, they should cover the cost of replacing and renewing cards.

During the stage-6, co-creation of meaning, the team explored many issues and possible situations that could arise. The outcome from stage-6 was the understanding and development of system meaning. The team had also developed a language and terminology to define and describe the individual components, and output reports available.

It is not the normal situation when developing a common systems language, that the improvement team finds itself in a position where there is not some form of language in place. In most cases of improvement activities, the team is examining and improving systems already in existence within the organisation. In this case, this was a new system to the organisation and therefore no existing language was in place. Considering this an opportunity to ensure that a common language was developed, as process facilitator, it became the function of this researcher to guide the team in the development and distribution of a table of definitions and explanations of the equipment and processes to be used, a portion of the table is shown below as table 6:

Table 6, An excerpt from the explanation of terms for the Time and Attendance System

Situation	Definition/ Explanation
Time and Attendance system	The system of recording and reporting the time staff members arrive and leave the company premises. Referred to as the T&A system
T&A record	The record of hours worked by a staff member that will be available to the Human Resources Department, Departmental Managers and the member of staff whose record it is. Additionally the records will be made available to prove the hours worked to governmental inspectors if required.
T&A wall unit	A unit mounted on the wall close to an entrance and exit door. The unit has a display that shows the date and time
Proximity Card	A plastic card the size of a credit card containing a chip that when held close to a 'T&A' wall unit identifies the individual as arriving or leaving the site. The arrival and departure times being recorded in the individuals recods
System Administrator	A member of the Human Resources Department designated as the overall system administrator. His or Her duties will be the issue of proximity cards and the entry of the personnel information required.
Departmental Administrator	A person from each department designated to administer the day to day tasks such as entering attendance information manually to the system for members of their department. The departmental administrator will also run system reports on the hours worked.

Stage-6 concluded with the team distributing a glossary of terms to the workforce. The systems language developed was in use within the team, the challenge now was to develop the environment that would allow the successful introduction of the system.

6.1.8 Stage 7: Facilitate Emergence of Infrastructure to Improve the Situation.

The team had reached the seventh and final stage of the process. Stage-7 required the team to develop the infrastructure that would allow the introduction of the new system. This entailed the installation of the hardware and software in the locations previously identified. The system databases required populating with staff details and individual's photographs taken for their cards. Once the installation of hardware was complete, the system propagated with staff details and staff issued with their proximity cards, theoretically, the system could become operational. However, the team agreed that a system trial was required prior to its full introduction. To carry out the trial, a number of departmental sections were selected that would represent the various shift patterns within the company. The trial lasted two months and demonstrated that the processes and procedures developed by the team performed as expected. The situations of people forgetting their card and having to have information entered manually did arise however; as this was an expected occurrence, it caused no problems. Another common occurrence was individuals forgetting to clock in or clock out. This highlighted a need for the departmental administrators to contact staff and enquire as to their attendance on those occasions. This imposed additional working requirements on the departmental administrators. However, this function was required to ensure records were correct and therefore the staff enquiry was unavoidable. With the exception of the expected problems, regarding forgotten cards and failure to clock in or out, the system performed as expected. As the problems encountered were expected and in operation would always occur to some degree the team decided implementation of the system should commence.

With the introduction of the system, the main work of the improvement team concluded. However, the team met one last time after the system had been operational for three months to review their understanding. During the preceding months, the system had

become part of the daily routine of the workforce. People were using the system without problem as part of their daily activities; The 'Time and Attendance System' had become part of the organisational infrastructure.

6.1.9 Case Review: The Improvement Process in Use

The system in operation has performed the function of recording individuals working hours as expected. The time and effort taken by the improvement team to communicate the need for the system to the workforce, paved the way to acceptance. As expected, situations have arisen when individuals have forgotten to clock in or out, as they arrive or leave. Nevertheless, the social reactions against the system have been avoided through the efforts of the team and the use of the second order organisational process.

Supporting the team, gave this researcher an insight into the interaction and development of what has become lasting co-operative relationships between team members. The team started the process as a group of interested individuals. Moving through the various stages of the process not only allowed them to understand the situation under investigation, but each other as people with opinions and ideas that may differ from their own, but nevertheless, be a true representation of the view of the world held by another individual. Relationships form the basis of 'second order' and the development of an 'I-Thou' working relationship occurred as the team swapped ideas, opinions and came to recognise and accept as the worldview of others. To say that no problems or disagreements occurred within the team would be incorrect. Individuals who had in the past engaged in debate to come to a decision as opposed to an agreement on the way forward, naturally found it difficult to override debate in preference of dialogue. The difference being in debate individuals say, however politely or well phrased, "*my way is the best way*" and you should forget your ideas and do what I say. While within dialogue, the approach is *"I have my ideas, but am willing to listen to yours and adapt my thought to accommodate your*

opinions as much as possible, as long as you are willing to do the same". Difficulties did arise and disagreement did occur, debate did at times surface, these situations were expected. People conducting such improvement activities inevitably will disagree on the best way forward, there will be differences of opinion. However, it is the responsibility of the process facilitator, to encourage dialogue and explore the differing worldviews and the assumptions and beliefs underpinning them. The team had such difficulties in the development of the system, however, as relationships developed and trust grew the exploration of worldviews diffused, what could have developed into an adversarial relationship based on debate, with one individual attempting to impose their opinion on others.

In this case, the process proved successful, enabling the team to develop and introduce the new system without the social problems envisaged by the management. The members of the improvement team commented on the additional benefit of the lasting relationships developed between them, and the development of the ability to understand and appreciate the views and opinions of other team members. These relationships carried on after completion of the process and became useful in working with each other on subsequent occasions.

6.2 LUNG DEMAND VALVE RUNNING ON

6.2.1 Introduction: The Situation of Concern

Shown below is a PA90 Lung Demand Valve. 'The Lung Demand Valve' is one of the major sub assemblies within a self-contained breathing apparatus set. The function of the lung demand valve is two fold: firstly reducing air pressures and secondly to deliver air into the facemask as the user inhales.

Figure 8, Lung Demand Valve sourced from Google Images

A self-contained breathing apparatus set consists of six major sub assemblies as listed below:

1. Carrying system (Back plate and Harness)
2. Air Cylinder
3. Pressure Reducer
4. Pressure Gauge
5. Lung Demand Valve
6. Breathing Mask (not shown on Figure 6.3)

Shown at figure 9 is a typical search and rescue breathing apparatus set with the main components listed above.

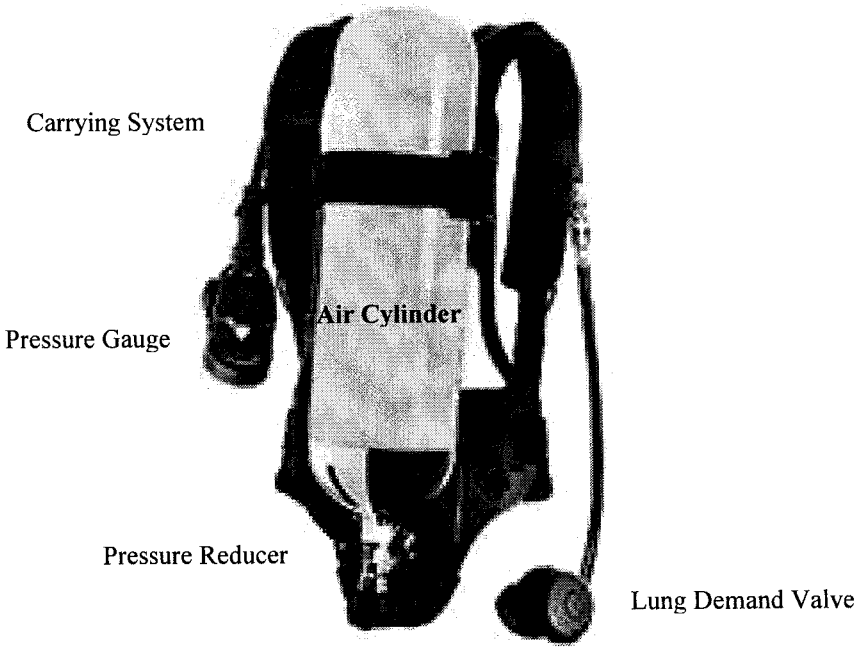

Figure 9, Typical Self Contained Breathing Apparatus. Sourced from Google Images and Adapted (labels Added)

To help in understanding the case study, a short introduction into the operation of a typical search and rescue breathing set is required. As stated, the set consists of six subassemblies one is the carrying system; used to mount the cylinder and pressure reducer and provides a means for the user to carry the complete system. The other components excluding the breathing mask make up the pneumatics of the breathing set. The set pneumatics reduces high-pressure air to a pressure suitable for breathing. The individual sub assemblies perform the following functions:

Air Cylinder

The 'cylinder' is a reservoir of compressed air, ranging in capacity from 6 to 9 Litres with a pressure of up to 300 Bar. They can be used singly, the most common form, or as a twin pack to give a longer usable duration.

Pressure Reducer

The function of the Pressure Reducer is to reduce the pressure of the high-pressure air within the cylinder, which as mentioned can be at pressures of up to 300 Bar, to medium pressure air at around 5 to 6 Bar. This medium pressure air, then flows to the Lung Demand Valve. For the case study, the internal operation of the pressure reducer, is not important, the important point being, the pressure reducer supplies medium pressure air at a pressure of 5 to 6 Bar to the 'Lung Demand Valve'.

Pressure Gauge

Connected through a hose to the high-pressure side of the pressure reducer, is the pressure gauge. This serves two functions. Firstly, as the user consumes air, the pressure within the cylinder drops. The gauge indicates the remaining pressure within the high-pressure side of the reducer, and therefore the pressure remaining within the cylinder. Secondly, the gauge hose, or gauge itself houses a low-pressure warning whistle. The whistle is activated, when the pressure within the cylinder drops below 60 Bar; warning the user, that he or she should evacuate the scene immediately.

Lung Demand Valve

The Lung Demand Valve takes medium pressure air from the medium pressure side of the pressure reducer, reducing it to a pressure just above atmospheric pressure, and supplies it into the user's facemask as he or she inhales. This supply function of the Lung Demand Valve is described in simple terms in the following way. When the user inhales, the Lung Demand Valve senses the drop in pressure within the users mask, causing the valve to open and deliver air into the mask. When the user exhales, the pressure the pressure win his or her facemask increases, and the valve closes, shutting off the supply of air. The supply and shut-off of air as the valve opens and closes, means that air is supplied to the user only when necessary therefore, extending the usable duration of the breathing set.

The Lung Demand Valve (LDV) therefore is an integral component within a breathing set; any malfunction of the LDV, especially when in use, would endanger the life of the user and consequently, constitutes a serious quality issue. As a result, the problem explored within the case study, was a serious concern to all, affecting the quality, design and manufacturing personnel. A team formed by the quality department intended to use the first order PSP. However, the Quality Director in agreement with the Production Director instructed that the second order process should be applied to facilitate an understanding of the problem and develop a sustainable solution.

6.2.2 Stage 1: Listen For Situations of Concern or Improvement Opportunities.

In late 2005, rumours began to circulate between the sales representatives in Germany that a problem existed with LDVs. The rumours concerned the LDV running on, a condition in which the valve fails to close as soon as the user exhales. This condition, delivers air into the facemask for a short period while the user exhales. While this fault is not critical, it can lead in a small number of cases to the LDV eventually going into a state of constant flow. When constant flow occurs, the valve remains open, continually delivering air to the users mask. The rumours grew, with some of Northumberland Manufacturing' sales agents within Germany, claiming hundreds of LDV running-on incidents were occurring. However, none of the agents could give specific verifiable instances and supply the serial number of the LDVs exhibiting the running on and eventual constant free flow problem. However, in early January of 2006, a complaint received from the German Fire Brigade training school maintained that a number of 'LDVs had exhibited running on during training sessions. In addition, some had eventually gone into a constant free flow state. This was the first, and as it eventually turned out the only reported case of the phenomenon actually occurring. The German Fire Brigade supplied a video clip of the LDV in the

constant free flow condition demonstrating that it was not possible to stop the flow of air from the valve.

At that stage, only the members of the quality department and a small number of production engineering personnel knew of the LDV rumours. However, as the situation changed from rumour to a specific instance of a LDV constant free flow failure, the situation required remedial action and the involvement of other departments. However, the situation was certainly not clear-cut or straightforward. At that point, all the company knew was, a small number, ten, of confirmed instances existed. Firstly, all ten showed signs of running on, with subsequently three units gong into a constant free flow state. However, if the rumours were true, there was the possibility of hundreds of unreported instances occurring. However, when again requesting sales agents to give specific instances, none was forthcoming, thereby pointing to a lower number of actual failures than the rumours suggested. Nevertheless, the situation was a cause of concern on two fronts. Sales agents reported that the rumours, although unsubstantiated, were having an effect on customer confidence. Once, the occurrence of constant free flow failure had occurred, with products that had undergone and satisfied the standard testing procedure, the possibility of faulty products being supplied to other customers arose.

However, the fact that some LDVs had exhibited the phenomenon of running on and subsequent constant free flow was not in itself the problem, but the observable outcome, of some underlying issues with this particular generic LDV type. Some individuals found it difficult to grasp the distinction and understanding of this 'cause and effect' situation. While spoken of as the problem, the observable phenomenon of running on and free flow was 'not the problem', but the 'observable effect' of the problem or problems. From a systems thinking perspective, it became the responsibility of this researcher to bring to the forefront the difference between, the observed effects that were incorrectly described as the

problem and the underlying causes. Which, in reality was the problem or problems leading to the observable effects? A simple medical analogy is the difference between symptom and illness. The symptoms are observable effects of the illness and not the illness itself. Furthermore, a given symptom may be the result of more than one illness. The question then becomes what illness is causing the symptom and how is it to be treated. In the case of the LDV, the question was what illness (problem) was causing the symptom (effect) of running on and constant free flow.

From its initial development, the type of LDV causing the situation of concern had suffered from what was termed 'valve block leak'. A state where there is an extremely small but constant leak from the air supply valve.

In essence, the problem of the LDV entering the constant free flow state was an extreme case of 'valve block leak'. A situation examined on many occasions utilising the first order Problem Solving Process to determine the cause and solution without success. This was one of the reoccurring situations, mentioned in the primary research interviews as problems. A problem that suddenly appeared for no apparent reason and just as suddenly disappeared before the cause was established. Remembering that in systems terms, these problems were in actuality, systematic observable effects, of underlying issues. Still, the situation had escalated, into the extreme case, where the valve allowed air to vent freely after being in use for some time and once entered, this condition was irreversible. To complicate the issue there was no existing test that would indicate the existence of the potential free flow state occurring within a particular LDV. For a user this free flow state is a dangerous situation, it means his or her air supply depletes rapidly resulting in the need for immediate abandonment of the rescue situation. For this reason, the Quality Director requested the use of the second order process to develop an understanding of the cause or causes of the problem. Determine the issues behind the running on and subsequent constant free flow, and develop a solution in order to maintain the safety of the user and

regain their confidence. In this instance, the improvement process was to continue, until an 'understanding of the underlying situation'; causing the free flow situation became established. A permanent solution had to be developed not prematurely abandoned, as it had been in the past.

Following discussions between the Quality and Production Managers, they arrived at a decision that the second order improvement process would be the method used to develop the solution to the LDV problem. However, by that point in time, a team had been established to examine the situation from the perspective of the first order Problem Solving Process, the standard improvement process used within Northumberland Manufacturing. This posed a problem for the stage-2 second order improvement process. Nevertheless, the two senior managers concerned, instructed the team to follow the second order process as closely as possible and requested this researcher to join the team as the second order process facilitator.

6.2.3 Stage 2: Create volunteer research team from interested people

Stage-2 has the function of bringing together a team of volunteers who share an interest in the problem and wish to participate in developing a solution. However, as already mentioned, in the case of the LDV problem a team was in existence whose leader intended to use the first order Problem Solving Solution to investigate the situation. Therefore, the team was already in existence when stage-2 commenced. Fortunately, the team had not at that point conducted any meetings. To move from the first order to the second order process as facilitator, this researcher firstly arranged a meeting to establish if the members of the team would feel able to utilise the second order process. Alternatively, they may wish to disband, in order to enable the formation of a team of volunteers in line with the second order processes requirements. The team consisted of members of the quality, design, and manufacturing and did constitute a body of knowledge suitable to the situation

of concern. However, the team leader who belonged to the Quality Department did express reservations about the use of the second order process, nevertheless, he did agree to its use. Thus, the original first order PSP team became the second process improvement team.

One of the issues the team needed to address before the process could succeed was to agree that team members would engage in dialogue, sharing thoughts theories and opinions freely, regardless of their particular departmental concerns. People taking a departmental stand, shifting the burden to others whenever possible, claiming it was not their concern would not allow second order understanding to develop. One of the roles of the process facilitator for the reasons outlined in the preceding case study is to ensure dialogue, not debate, formed the communication method utilised by the team. This was to become a challenge during the coming months. The team consisted of individuals who for years, had engaged in debate to influence others to their point of view. Overriding others views and opinions, in order to enable their personal or departmental view takes precedence. Abandoning the practice of debate, replacing it with dialogical examination proved difficult to some members of the team, especially those in managerial positions within their individual departments. Nonetheless, dialogue is required to enable the exploration of each other's views and opinions, leading to a shared understanding that encompasses the views and opinions of the team. Additionally during conversations, the team decided that the affected German fire brigade, and test authority should be informed of all deliberations and developments. This decision came about as the first step in regaining customer confidence, by making all information available to both external bodies. This effectively was a decision to commence stage-5 immediately. The German fire brigade training school had supplied the testing authority with five unused LDVs, still in their delivery packaging for testing. Carrying out the normal test in Germany, only confirmed the results of tests conducted at Northumberland Manufacturing before dispatch. However, this did

confirm the findings at Northumberland Manufacturing, gaining the agreement of the testing authority that the standard tests did not give any indication that a particular LDV would fail in extended use.

Stage-2 ended with the team formed, not from volunteers, but from individuals instructed to participate. While this was not the usual manner of team formation within the 'second order' process, it was the norm for Northumberland Manufacturing. However, the team did posses the knowledge required, and was in a position to enlist the assistance of other individuals from the workforce. The team had reached agreement on the use of the second order organisational improvement process, agreeing the commencement of stage-5 immediately, in order to widen the understanding of the team and encompass the understanding of the situation through the worldviews of the personnel from both the German Fire Brigade and the people at the testing authority.

6.2.4 Stage 3: Explore differing Understandings and Worldviews.

As stage-3 began, the team came together to conduct initial discussions on the problem from their individual perspectives. While agreeing to use the second order process, the team agreed to document the process with the standard storyboard and action list documentation used within Northumberland Manufacturing. As this situation was a concern to not only the UK division, but also the group in general, the team took the view that standard documentation used within all group divisions was necessary. Unlike the previous case that required and used little official documentation, this case required full documentation and tractability of all tests carried out. During the first meeting, the focus of attention was on defining the actual situation encountered. The team defined the current situational state as a, *"reported "air loss" or equivalent (free flow/running on), occurring on 10 units to date"*. This was *"affecting market confidence"*. They also decided to *"request more information on the "100's" claimed"*.

The video clip supplied with the notification of a fault from the Fire Brigade training school, did not give a great deal of information or depict anything more than a Lung Demand Valve in a constant free flow state. While this proved, the condition had actually occurred, it gave no indication of why or how the condition arose. Therefore, to gather more information on the issues, and demonstrate the importance and urgency of the situation to the customer and testing house, a design engineer and a quality engineer were despatched to Germany. Their brief was to observe the training exercises and attempt to reproduce the situation that caused the failure, noting the circumstances such as; the used length of time, external air temperature and the temperature within the exercise chamber at the time of the failure, along with other information they thought relevant. If it was possible to reproduce the failures, they were to bring the Lung Demand Valves back to the UK for extended testing in the companies' laboratories. On their return, the Design and Quality Engineers reported to the improvement team that two units had displayed running on and constant free flow during their observations. Adding that the units were now at Northumberland Manufacturing for testing, and the intention was to write an interim report following extended tests.

Following the testing of the two LDVs the interim report contained the following conclusion:

> *Conclusion*
>
> *On these LDVs only one could be made to go into constant flow. The LDV, which did go into constant free flow, had run for over 300 minutes at different breathing rates before constant flow could be found.*
>
> *At present, it must be concluded that the root cause of the problem has not been found.*
>
> *Further testing will continue to replicate the operation during training at the German training school.*
>
> *The next approach will be to have a hot LDV and cold air from the cylinder. The use of moist exhaled air in system is also to be considered.*

All of this testing assumes, the air in the examined cylinder is dry. There is no reason to indicate otherwise.

As the interim report stated, at that point it was not possible to identify the root cause or causes of the observed effects. However, more information was now available to allow the team to form personal opinions and agree actions based on the test results.

Additionally, management had issued an invitation to the German Fire Brigade for representatives to visit Northumberland Manufacturing. The intention of the improvement team was to commence the stage-5 process, to initiate wider dialogue as soon as practically possible, while simultaneously implementing the process of rebuilding customer confidence. The visit was to include; a tour of the manufacturing process and discussions of the situation, conducting an exploration and exchange of thought and opinions, and agree the way forward and future actions, at both Northumberland Manufacturing and the German training school. This visit took place facilitated by a member of the main board from the Germany headquarters. The involvement and facilitation of the meetings, between Northumberland Manufacturing and the German fire brigade personnel, by a member of the most senior management of the group, again demonstrated the importance of rebuilding customer confidence, and developing a lasting solution to the issues of Lung Demand Valves running on and entering a constant free flow state.

Before the meeting with personnel from the fire brigade could take place, the team required additional information. This was obtained from the testing of a larger sample of defective 'Lung Demand Valves'. A request to the training school to supply the original faulty units and any others displaying the same phenomenon, gave the opportunity to examine a batch of nineteen units.

In addition, the training school completed a question and answer document that gave details of the use of the Lung Demand Valve units, and the cleaning and storage of face masks used within the school. The Questions and answers are show below:

Q: Under what temperatures did the incidents occur?

A: At temperatures between 0 and -5 degrees Celsius

Q: Which masks were used?

A: Panorama Nova masks R52972

Q: Had the masks been cleaned immediately prior to use - could there have been residues of water?

A: The masks are cleaned and tested after each use. When a student is ready for training, he will be given a cleaned and newly tested mask

Q: If yes to the above, how have the masks been dried?

A: The masks are dried in a drying cabinet after they have been cleaned and disinfected. After this, they are tested and hung up to dry on a rack for at least 16 hours. This is done in order to get rid of any water applied when doing the testing.

Q: Were the users experienced or new students?

A: Six of them were "new students", BUT it has also occurred for one of our experienced instructors (instructor/safety fire fighter) that the LDV is hissing during use and shuts off slowly.

Q: How was the free flow from the LDV? Was it a hiss, a weak flow or a heavy (unrestricted) free flow?

A: It is experienced during use that the LDV is getting slower and slower in shutting off upon each breath. During continued use it will turn into a steady hissing.

Upon pressing the red button (when the LDV is removed from the mask) a hissing/weak flow noise is heard. This tends to stop after having had the LDV in the hand for a while (varies from anything between 2 seconds to 3 minutes)

The returned Lung Demand Valves underwent close examination and testing including dimensional checks, the surface finish of the valve cylinder bores, the lever height setting and extended performance cycle tests. Following the examination, it was not possible to identify a specific cause or combination of causes attributable to the problem under investigation. However, the team had identified three areas that could possibly be attributed to the problem. These were the strength of the valve spring, the surface finish of the valve block bore, and the set height of the valve-operating lever. All three areas would

require in depth analysis and a series of trial and tests to establish the effects each have on the overall 'Lung Demand Valve' system

By this point, the personnel from the fire brigade had concluded their visit and held discussions with senior management and the improvement team. Each individual from both Northumberland Manufacturing and the German fire brigade took the opportunity to share their thoughts and opinions. An understanding had grown within the brigade personnel, of the importance placed on finding a solution by all the people at Northumberland Manufacturing, especially the improvement team. At the conclusion of the visit, the team, with the agreement of the fire brigade personnel, decided that the stage-4 analyses would concentrate on the three areas, previous testing and dialogical discussions had indicated were the most probable contributing factors to the underlying causes of the observed effects. 'A way forward' document was produced which contained the following points:

German Fire Brigade Visit to Northumberland

Agreed Way Forward

1: Constant flow and running on has been witnessed at the Fire Brigade. (This is accepted)

2: Laboratory testing has not shown up this characteristic easily. (This may be temperature related)

3: Most claims are from the brigade specifically during winter months and during training exercises within the fire training facility (This also support the theory that this issue is temperature related)

4: Dimensional checks by Northumberland Manufacturing Safety prove all components to be within Specification.

5: Cylinder bore on Lung Demand Valve No. 6 showed "pick up" related to dynamic/static friction. (Potential root cause)

6: Surface finish on other cylinder bores are deemed to be not to our standard requirement for surface finish. Creates dynamic/static friction issue as per no. 5 above. (Potential root cause)

7: Possible increase in spring force may eliminate "pick up" –dynamic/static friction issue. (Potential root cause)

8: Verification by the testing authority - breathing simulation as per human dynamic training to continue during winter.

Thus, stage-3 concluded, with the team having developed an understanding between themselves and the fire brigade, one of the leading German customers of Northumberland Manufacturing. The team had agreed on the way forward, and decided on the investigations and analysis required in stage-4. Similarly, the team came to the understanding that in order to be able to conduct the required trials, other departments such as the machine shop and the development laboratories would be required to assist in the preparation and testing of samples. Problems and disagreements had occurred, but the primary concern of each team member was the pressing need to identify and correct the underlying issues, that were causing the failures. Facilitation of the second order process had maintained the dialogical direction of the team's deliberations. However, the temptation to revert to debate, especially when some members wanted to home in on a single subject, such as the lever height setting, thereby excluding all other possibilities, did have to be controlled. In this situation, the team required a reminder that the lever height setting had been the centre of several attempts to cure the issue of valve block leak on numerous occasions without success, and that it was essential to consider other possibilities. However, while the lever height required investigation to confirm the part played in the leakage problem, the other possible causes also required consideration. Thus, stage-3 moved into stage-4 and the analysis of the three agreed areas.

6.2.5 Stage 4 & 5: Analyse Multiple Perspectives to Outline Themes; Define System Boundaries, Initiate Dialogue around Emergent Themes; Gain a Wider Understanding of Mental Models

Stage-4 is used to analyse the multiple perspectives generated from stage-3. However, in this instance stage-5 would run in tandem with stage-4, as it had ran in tandem with preceding stages. The team realised that this combined stage was central to the

development of an understanding of the interaction of the three areas and effects these interactions have on the Lung Demand Valve system. Stage-4, defines the system. However, the system under investigation was the LDV Unit. Therefore, it became possible to define the first order boundary as the LDV itself as shown in Figure 8, along with the equipment and assembly operations used to manufacture the units. Additionally, the first order boundary would contain the data produced from tests, to determine the effects and interaction of the various components on the observed running on and free flow conditions. Thus, stage-4 analysis combined with the stage-5: widening of understanding to individuals external to the improvement team. This expansion thereby, included sub groups containing individuals with the knowledge and ability to produce and test LDV components and assemblies. Additional, specialised equipment would be necessary to produce graphical trace results of breathing tested carried out on LDV units. Thus, several sub teams came into existence, to produce specific components and conduct the various tests and statistical analysis required. The widening of the number of individuals involved in the improvement activity, allowed the team to gain additional input to the pool of thought and beliefs that formed the joint understanding. The stage-5 pool of knowledge, already containing understandings from the improvement team, group and plant senior management, the German fire brigade and their training school along with the equipment testing authority, became extended further with the inclusion of specific manufacturing and testing expertise. The manner, in which stage-5 implementation took place, enabled the formation of an extremely rich picture of the varying viewpoints of the numerous parties involved. Therefore, the first order boundary was the units themselves, the equipment utilised in their manufacture and the data available from standard tests along with data produced from test specifically designed to investigate the underlying issues of the running on and constant free flow issue.

The positioning of the second order boundary however, was a little more difficult. The team began to consider the possibilities, and the numerous possible second order boundary placements. Taking the stance of Churchman (1970, 1979), by setting the second order boundary as widely as possible in order to provide the richest picture available was not practical. Following this path, would mean every customer and user of the LDV type under investigation, would need to be included and therefore, informed of the team's past and, as significantly proposed actions. More importantly, two-way communication of thought and opinions would be impossible with thousands of customers. While theoretically, this would be the ideal positioning, practicalities made this position for the second order boundary simply unworkable. Therefore, the team took the view of Ulrich (1998), that the analysis undertaken would impose restrictions on the positioning of the second order boundary. In essence, this was the position the team found. The social analysis of the views of those affected would require a selection of included organisations in order to maintain a workable boundary placement. Thus, the second order boundary was set to include, Northumberland Manufacturing personnel and selected personnel from external customers and component testing establishments. The boundary encompasses all those involved in the manufacture of components and assembly of the LDV, along with individuals engaged in testing and development of data. The team also decided to include externally involved individuals: the individuals from the fire brigade who had taken part in the initial investigations, along with the personnel from the fire training school where the failures actually occurred. Additionally, the German testing authority would be included in the second order boundary. As no other customers had been able to give specific instances of the fault occurring with their LDVs, the team agreed not to include them inside the second order boundary.

The definition of the second order boundary is subjective. In some cases, such as the time and attendance system previously discussed, positioning can include all those affected.

However, in the case of the LDV, the number of possible organisations and groups affected became so large that the widest boundary setting that allows total inclusion as advocated by Churchman (1970, 1979), becomes a practical impossibility. In such cases, the only practical alternative satisfying the second order improvement process is that identified by Ulrich (1998), as allowing the analysis required to define the positioning of the boundary should be utilised. This approach excludes some of those involved, while including those with the greatest possible input, giving the widest and richest understanding to be developed. The team agreed that, as the groups included, were the organisations that had actually experienced the phenomenon of running on and constant free flow, those excluded would only be able to make an extremely small contribution to the overall knowledge of the situation. Therefore, the consensus was that the second order boundary should be set in line with the thoughts above. A third group included were the sales agents within Germany. The sales agents would eventually have the task of communicating the team's actions and final solutions to customers, who while not affected, were nevertheless worried.

Having defined the first and second order boundaries, the task of actual production of test components and subsequent analysis of data produced from extended tests could begin. The following sections consider the areas agreed by the team for in-depth analysis during stage-4:

Lever Height

Activation lever height had been the subject of investigation on several occasions prior to the issues presently under investigation. The function of the activation lever is to move the valve piston in the vale block to open and close the flow of air through the demand valve. The initial height setting controls the sensitivity of the valve; set too high and the valve will leak constantly. Therefore, the lever height is normally set as close to the lowest

setting as possible. This setting position is 'the default' and referred to as 'bottom line' by the workforce from the gauge used to check the height. Bottom line is used in preference to the upper height setting' referred to as 'top line'. Normally the height of the lever at that time was set using an automated piece of equipment. However, the discontinuation of the practice of checking the automatic setting using a hand held gauge, occurred several months previously.

The lever height setting of the returned units, were as expected set primarily to bottom line with some set at top and others in between. However, one was set to a position below the accepted lower limit. In order to conduct analysis on a random sample of LDV lever heights, twenty Northumberland Manufacturing stock units were utilised in setting, examination, and other subsequent comparison testing. As it was also possible to examine the position of another internal component, while examining the lever height setting, the team agreed to carry out this additional examination although it has not been identified as a possible cause. The component was the anti-injector pipe, a component that directed airflow within the demand valve body. While the positioning of the anti-injector pipe was not considered a contributing factor, the team agreed that examination of the positions within the sample would provide additional information that may aid the final analysis and understanding. After the results became available, the improvement group conducting the investigation produced the following summary.

> *Summary*
>
> *Of the 20 ex stock LDV's tested 8 have run-on after 15 to 20 minutes of breathing at the low breathing rate, 12 lever heights are on bottom line of gauge and 8 lever heights are in the middle of gauge. Three anti-injector settings are outside specification, only one of these has been highlighted in the test bench database as being adjusted, it is therefore unknown how many of the remaining injector settings are outside specification. The 20 ex stock units all remained positive with the worst case being one unit at 0.3mbar.*
>
> *From the samples tested, there is no correlation between lever position, anti-injector setting and running on.*

However, the summary fails to mention, that in three instances levers were set outside the allowable limits; two set low, while the third was set above the allowable height. LDV assembly management, with the agreement of production management had discontinued the practice of manually checking the setting of all lever heights some months previously, considering it unnecessary. The consensus within the team was that the manual check of lever height, would have found these discrepancies and allowed manual resetting, thus rectifying the units that were outside the required specification. While the report stated that, there was no correlation between lever height and the situations under review. Stock items ready for dispatch to customers, with 'out of tolerance settings' is an unacceptable situation and may cause other problems. Therefore, the team recommended, the immediate reintroduction of the manual checking of lever height. Despite the out of tolerance conditions of the lever height, and anti-injector pipe setting, the team agreed with the conclusion, that there was no correlation between lever height and the running on or constant free flow seen in the failed LDV units. Consequently, the lever height was discounted as an underlying cause of the situation under investigation. A secondary benefit of the investigation was the developed understanding of the effects of the lever height, and the conclusion that in isolation it would not cause the observed effect previously attributed to the activation lever.

Spring Strength

One of the conclusions in the way forward document from the joint Northumberland Manufacturing and the German Fire Brigade dialogue meetings was that the spring force used to hold the valve closed could be increased to overcome identified frictional issues. The point made within the report was, the "Possible increase in spring force may eliminate pick up" dynamic/static friction issue. The report highlighted the friction as a, "Potential root cause." The function of the valve spring is to close the valve against the force of the airflow whenever the user exhales. This function, accomplished with an internal

diaphragm, sensing the increase in pressure within the user's mask causes, with the assistance of the lever spring, the movement of the actuation lever and closure of the valve. Thus, the flow valve opens and closes, as the users breathing pattern demands. Consequently, the use of stronger springs required testing, to ensure the valve would still open without the user being required to inhale strongly, to overcome the pressure of the spring holding the valve closed. During the initial design stages of the LDV, the design engineers had calculated the effects of using varying spring strengths. Revisiting these calculations the design department advised that use of slightly stronger springs would not adversely effect the normal operation of the LDV. However, testing would still be required. Therefore, the twenty units previously drawn from stock and the returned units with replaced valve blocks, if required, functioned as a sample batch for the purpose of testing stronger springs. The testing of the units, following the fitting of stronger springs, confirmed that normal operations were uncompromised. The units when subjected to long-term breathing tests did show a lower number exhibiting the running on phenomenon. While the use of stronger springs improved the situation of concern, the team came to the shared understanding that this was only a partial solution, and other underlying issues existed.

Surface Finish

On examination of the units that had exhibited running on and constant free flow, all possessed high surface finishes in the valve block cylinder bores. The surface finish specified on the component drawing was a general minimum surface finish tolerance, meaning that higher finishes than the one specified were acceptable. Additionally, it was noticeable that a film of lubricating grease was no longer present in the cylinder bores. In addition, signs of frictional damage were evident. This lack of lubrication, as mentioned in the initial report, meant these units required significantly higher forces to move the piston within the cylinder bore. Considering that, these failures had occurred in a training situation, where units are used for considerably longer periods than in normal rescue

situations before being stripped down and re-greased; the high surface finishes would mean the lubricating film of grease had been exhausted before the training school had the opportunity of cleaning and re-greasing. This finding could indicate that the high surface finish may become a contributing factor, almost a distinct possibility, to the LDV failure. Discussions with machine shop personnel, regarding the process used to machine the valve bores revealed a recent change in the method of production. The machine shop and production management, had agreed this alteration to reduce production costs through the reduction of component cycle time. One of the side effects of the change was a higher surface finish to the valve bore. The improved surface finish, combined with the extended periods of use in the training school, appeared to be a significant contributing factor to the issue of running on and the constant free flow problem. However, this assumption, while held by all the members of the team, required statistical investigation to verify its validity.

Therefore, the team requested the machine shop to form a group to manufacture a number of sample valve cylinders batches. However, before commencement of manufacture, the improvement team requested the design department to specify both a lower and upper surface finish limit. Having received the upper and lower limits, the machine shop conducted manufacturing trials to establish the optimum method of production to maintain the specified tolerances. The six methods used were as follows:

- Cylinder bored
- Cylinder bored and reamed
- Cylinder bored and burnished
- Shef-cut floating holder;

  (shef cut is a specialised cutting tool that produces accurately dimensioned bores as required in the valve block)
- Shef-cut solid holder
- Shef-cut and burnished using solid holder.

Having used the various methods, the machine shop personnel conducted process capability studies, to ascertain the optimum method of producing the valve bores to give the required surface finish. A report produced containing graphical representations of the findings was supplied to the improvement team. However, the senior management at Northumberland Manufacturing believed that the data and results contained within the report to be commercially sensitive, and hence requested it not be reproduced as part of this thesis. However, they had no objection to quoting the summary of the investigations as shown below.

> *Summary*
>
> *Of the six machining methods tried, method 4 (shef cut with a floating holder) gave the highest capability indices for Ry (Cp1.65, Pp1.61), however the data is skewed towards the top specification limit with an $\bar{X}$ of 3.1 against a target of 2.7 which results in a Cpk of .73and Ppk of 0.72*
>
> *Machining method 4 (shef cut with a floating holder) also gave the highest capability indices for Rmrd (Cp0.67 Pp0.72 and Cpk0.39 and 0.42), however both these indices are below recognised SPC standards for capability indices of Cp / Pp > 1.67 & Cpk/Ppk > 1.33.*
>
> *Machining method 5 (shef cut with a solid holder) gave the highest capability indices for Ra (Cp3.38, Pp3.45), however the data is skewed towards the top specification limit with an $\bar{X}$ of 0.39 against a target of 0.26 which results in a Cpk of 0.25and Ppk of 0.26*
>
> *From the results of the small sample tried to date it would appear it will be very difficult to maintain a controlled and capable machining method capable of meeting the three surface finish criteria proposed.*
>
> *A decision will be required from PSP233 team whether samples from these machining trials are tested by R & D, for long-term Lung Demand Valve performance. Or one of the above machining methods is chosen and a larger sample produced to conduct capability analysis on, or manufacturing continue to trial alternative machining methods to achieve the three proposed surface finish criteria.*

Having decided the most appropriate production process, the machine shop produced a batch of thirty cylinder valves with their surface finish controlled to top tolerance, and

following manufacture of the batch, the quality department conducted extended breathing tests.

Having concluded the tests and trials thought appropriate within the stage-4 analysis the various teams had created 223 megabytes of information, in 239 files, over a period stretching over 12 months. With the exception of the excerpts shown, the organisation considered the data to be commercially sensitive, and have requested it not be issued to the public domain; consequently, it has not been included as an appendix.

Coming to an understanding of the underlying issues, had been a long process. However, the use of the second order process had allowed the team to explore issues and the combination of effects of the various components of the system. Compared with the first order Problem Solving Process model that was initially proposed, these issues would not have been explored, or examined. The team had concluded that the main causes of the running on and constant free flow issue was the high surface finish in the cylinder bore, compounded by the extended periods of use within the training school situation. As almost a year had elapsed since the failures in Germany, the team felt confident that, as no other occurrences had been forthcoming from other customers, the problem was restricted to the fire brigade training school.

Figure 10 shows that, although the situation was significantly different from the first case study, essentially the same process was taking place. While the second case contained vastly more analysis of factual data, the underlying principle of individuals taking differing stances on the data remains true. People interpret data in light of their own opinions and views of the world. What is significant to one individual can be insignificant to others. Examination of the data using dialogical principles, allowed each team member to express their opinion on the important aspects of the analysis. As Wittgenstein puts it:

' Human agreements decide what is true and what is false? It is what human beings say what is true and false; and they agree in the language they use. That is not agreement in opinions but in form of life'. (Wittgenstein, 1967)

Figure 10, depicts the layered second order process with the outer layer beginning stage-3 with the members giving their views. As the process moves towards the centre, data is examined from the perspectives of the individual team members' worldviews. Team dialogue, combines these worldviews through an examination and exchange of the individual perspectives, into an understanding that allows the central agreement of Figure 10 representing the agreement reached in stage-4

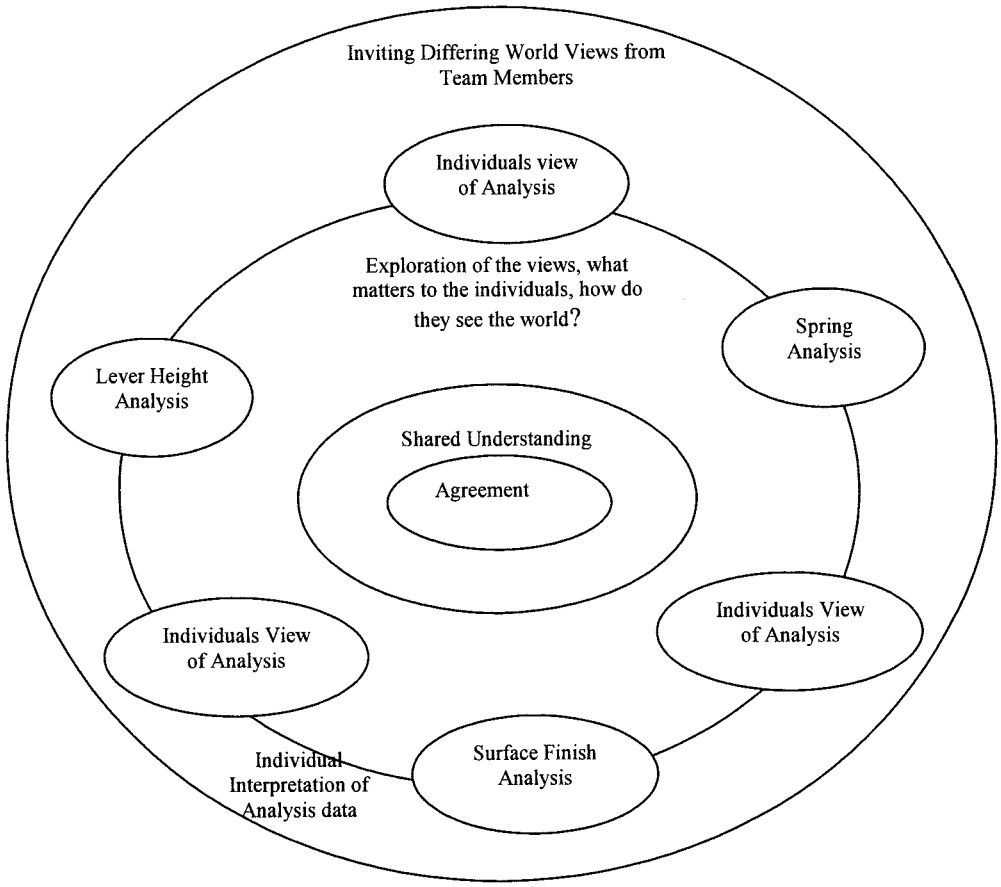

Figure 10, Exploration of worldviews and data analysis leading to a team agreement

The shared understanding developed was; the high surface finish of the cylinder bore caused the observable effects of running on and constant free flow. This underlying cause, exacerbated by the extended periods of use at the training school, formed the primary

combination of factors, that resulted in the initial running on and subsequent constant free flow observed situations.

However, following the extensive investigations and second order discussions the team agreed that:

- Surface finish in production situations should be maintained within the upper and lower limits used on the test samples
- The stronger springs used in spring trials should be fitted as standard
- A video made of the method used to re-grease the unit after use and as importantly to communicate the findings and solution arrived at by the team to be supplied to customers by the sales agents
- Advise customers of the recommended maximum useable time between cleaning and re-greasing
- Lever height manual inspections be continued as standard
- Drawings and test specification sheets amended to show the new limits.

Hence, some twelve months after commencement, stage-4 and stage-5 ended. The use of the second order process had developed an understanding of the LDV: An understanding never attained with the numerous applications of the first order Problem Solving Process. The challenge now was to communicate the meaning of the understanding to the workforce involved in the manufacture of internal components and assembly of the Lung Demand Valve.

6.2.6 Stage 6 & 7: Co-create meaning and evolve, the Language Addressing the Situation of Concern and Facilitate Emergence of Infrastructure to Improve the Situation

Stage-6, the co-creation of meaning and the evolution of a systems language, in this case undertaken with the extended groups during the involvement of departmental staff during stage-5, was almost complete. The systems language of the LDV developed during the original introduction of the LDV did not require amendment. The terminology was in use and understood by the workforce, field sales agents and customers. In this case, any attempt to modify the existing systems language would only lead to confusion. Stage-6, now required the communication of the meaning and understanding of the importance of the surface finish and correct method of greasing the valve bores to those individuals involved in the manufacture and assembly of the LDV units within Northumberland Manufacturing. Additionally, those involved in maintaining LDVs in external organisations required the information. This was achieved by, additional staff training and the distribution of a video to customers, giving an explanation and stressing the importance of the grease film.

The role of stage-7 is to facilitate the emergence of the infrastructure in order to improve the situation. As stated previously. The first action was to initiate the official process of changing the manufacturing and assembly drawings, to show the surface finish tolerance required. The second step was the introduction into practice of the agreed and tested manufacturing process. Thirdly, informing the personnel involved in unit assembly of the need for the use of the stronger springs, as soon as a reliable supply became available. These three actions, in combination with the re-training of assembly personnel and general review of the processes, with emphasis on the re-introduction and importance of checking the lever height, formed the primary internal infrastructure alterations. Moving to the

external infrastructure, as agreed, the quality department produced a video to show the recommended method of cleaning and re-greasing the LDV units after use, and distributed it to all sales agents involved. In addition to the video, all agents underwent training on the maintenance and importance of correctly re-greasing the units. Thus, stages-6 and 7 concluded, with the situation of concern understood, customer confidence restored and customer relations with the fire brigade vastly improved. As this is, a leading brigade in Germany, the improved relations has the additional benefit of, other brigades following the lead of this particular brigade in the continued use of Northumberland Manufacturing products. What could have been a commercial disaster, through second order understanding and openness with external customers previously unused, became a successful solution to a product and a customer relations problem.

6.2.7 Reflection on the Second Order Process

This case was complex, the problem initially was not clearly defined and little understood. It began with unsubstantiated rumours, yet, as already mentioned, numerous requests failed to bring to light any instance other than that at the training school. Having confirmed that a situation seen as a problem actually existed, the consequences with regard to customer confidence and future orders could have serious repercussions. However, even the problems reported at the training school, were symptomatic observable outcomes of unknown and little understood underlying issues. If the original first order PSP team had carried out the inquiry, they had already decided that the underlying cause was restricted to lever height setting. This, as it turned out, would have failed to uncover the combined effects of the spring, valve bore, surface finish and extended use. The team, especially the team leader, at first were hostile to the use of the second order process model. Eventually, this researcher convinced the team that issues other that lever height might be affecting the underlying cause or causes of the observed constant free flow condition. This and the

senior management instruction, to use the second order process convinced the team to use the process.

This was not an ideal situation. The initial compulsion of the individuals was to take part in the first order process, this, coupled with the subsequent instruction to use the second order process, contravened the principle of stage-2 voluntary teams. However, the use of the process meant that a re-think by the team members, on the possibility of numerous underlying issues existing took place. While at the time, this re-think seemed of little importance, as things developed, it proved an unintentional turning point that moved the team in the direction of understanding the underlying situation. Additionally, this case demonstrates that while the process may seem to follow sequentially stage by stage, however, when circumstances dictate, it is possible to follow an alternative sequence, or combine and use the stages as required. In the case of the LDV, one of the team's priorities was the restoration of customer confidence as quickly as possible. To enable the process of restoration of customer confidence to commence at the earliest opportunity, the initiation of stage-5 dialogue commenced almost immediately. Additional stage-4 analysis conducted in tandem with the extended stage-5, enabled departments such as the machine shop, development laboratories and product design, to become involved in developing wider understanding. Likewise stages 6 and 7 merged, reinforcing existing language, amending drawings and re-training production and assembly personnel. While simultaneously communicating with and re-educating external agents and customers, to develop the environment of change. At the conclusion of the process, examination of the underlying issues had enabled testing to confirm the thoughts and develop agreements on actions to be undertaken. The team agreed, that the second order process allowed this 'in depth investigation' and the emergence of the effects of the spring and surface finish combination. The process also confirmed that, while important, lever height had no direct effect on the problem.

6.3 SUMMARY: CASES STUDIES AND PROCESS

The given case studies demonstrate the ability of the process, to be applied in differing circumstances and with differing complexity of problems. The first case is what Armson (2003) describes as a difficulty. A problem clearly defined and understood. One with a limited set of events and conditions involved. Case one, the Time and Attendance System is in this category. The situation nonetheless needed careful thought and considerate communication to avoid the social problems envisaged. However, Armson (2003) and Checkland (1981) describe the problem encountered in case two the Lung Demand Valve as 'a mess', an ill defined and little understood situation.

Chapter 5, outlines the second order process and chapter 6, gives a detailed description of its use. The function of chapter 7 is to describe the development cycles conducted to develop the second order improvement system.

7 CHAPTER 7: REFLECTIVE DISCUSSION OF SECOND ORDER DEVELOPMENT

The aim of this chapter is to reflect on the development and implementation of the Second Order Improvement Process (SOIP). The first section looks at the selection of the core group used in the implementation trials of the SOIP. The chapter follows with an evaluation of each stage beginning with the intended use and outcome of the stage. The stage analysis continues, with an exploration of such issues as; how did people perceive the stage? Did it work? What were the issues? What new insights were being discovered amongst the explored topics?

7.1 PROCESS DEVELOPMENT AND IMPLEMENTATION

As already stated, the development of the 'second order' organisational improvement Process (SOIP) took place over a period of two years. With several iterations of participatory trials and observation on actual issues arising within Northumberland Manufacturing taking place. Following the initial process model conception from theoretical principles, the cycle of process trial proceeded in the following manner: valuation and amendment.

The proposal to develop a new form of organisational improvement process was publicised through the company's weekly bulletin. The bulletin contained a request to take part in a series of process trial implementations. Involvement of company staff from such an early stage was to ensure people perceived the process, not as an academic exercise but the development of a workable improvement process, usable by all departments within the organisation. Several individuals took part in improvement activities as part of their daily routine, in addition to the people who were simply interested in the new process who came forward as volunteers. This group received an introduction to the process philosophy, and the reasoning behind second order approaches to organisational improvement. All those present agreed, the principle of understanding the issues and aspects of the situations as of

importance to others, allowed a more in depth situational analysis. When individuals within a team originated from differing departments and disciplines, the ability to view the world from their perspective gave an opportunity to view perspectives not normally available to single departmental teams.

Whenever suitable issues presented themselves, trial implementations of the process followed with participative observations made by this researcher. Following the conclusion of the improvement activity, team members gave verbal feedback on their views of the process and their opinion of how it performed. They also added thoughts on possible improvements to the stages or process as a whole.

Accordingly, a group of interested volunteers from a number of departments throughout the organisation became the core group of people utilising and delivering feedback on the practical aspects of SOIP implementation.

7.2 THE STAGES OF THE PROCESS

The SOIP process has undergone development and refinement to become a successfully functioning model for an improvement process, based on a combination of second order and systems thinking principles. The following stage findings emerged from the observations made as the groups worked through the SOIP during their various improvement activities.

7.2.1 Stage 1: Listen for Situations of Concern or Improvement Opportunities

Stage-1 is essentially a core process concept; a continuous stage that once began becomes the driver of continued improvement, transforming the workforce into individuals who actively seek improvement opportunities.

In practical terms, stage-1 is the realisation within the workforce that they do not need to wait for problems to occur before utilisation of an improvement process. Unlike the PSP, the SOIP process is primarily an improvement not a problem-solving tool.

While the process model calls for individuals to "*listen for situations of concern or possible improvements*" this theoretical standpoint is, in practical terms, difficult to implement. People do not normally think about or have the possibility of improving situations they find themselves in until problems occur. Nonetheless, if individuals have as part of their view of the organisational environment, the mindset that improvements can be undertaken proactively. Meaning, before a problem occurs, before situations become problematic, the identification of situations is shared and improvements sought. This leads to the possibility of avoiding problems occurring, and improving situations not considered initially as problematic. Additionally stage-1 promotes the concept that improvements are not necessarily associated with the correction of problems. Stage-1 takes place in the minds of the workforce, with a view to increasing efficiency, providing enhanced customer satisfaction; improve order processing or any other improvement to organisational systems and procedures.

Stage-1 has had an influence on the organisation. The members of the core process group have changed their perception of organisational improvement. Now taking a proactive approach in exploring the situations they encounter and, as the stage suggests, listening to other peoples comments on the systems and process in use within the company. Stage-1 has developed the inquiring philosophy that leads to the identification of improvement opportunities in a proactive examination of everyday situations.

However, for the individuals concerned, acting proactively has not been a simple transition. The normal practice of reacting to problems as they occur is a deeply ingrained

way of working and approaching improvements within the organisation. The traditional outlook of the individuals within Northumberland Manufacturing brings the saying "*if it is not broken don't fix it*' to mind, yet this attitude and mindset is counter productive to continued improvement. Consequently, the changing of this attitude, through the continuous implementation of stage-1, improved the possibility of the continued improvement, through individuals actively seeking out improvement opportunities. This stage therefore is the foundation of the SOIP, empowering individuals to take control of the organisational improvement process. Implementing the stage is the beginning of the development of understanding others. It gives the individuals within the organisation, an opportunity to begin to exchange ideas enabling stage-2 to begin, the process of team formation to address issues emanating from stage-1.

7.2.2 Stage 2: Create volunteer Research Team from Interested People

The staff saw stage-2, as the complete opposite of the traditional method of team formation used by the organisation. Traditionally, managers told people they were to take part in improvement teams. This meant that people did not always have an interest in the aims and objectives of the team. Frequently, team members were uninterested and worked towards superficial quick fix solutions. This usually only alleviates the problem on a temporary basis, because short deadlines were imposed, and no time was given to finding a permanent solution.

The SOIP process moves away from the situation of imposed team membership to individuals volunteering to become part of the team. While individuals approved of the opportunity to join, or refrain from joining an improvement team, giving people the choice proved problematic. Most of the workforce had little time available for improvement activities. Allowing individuals to decline an invitation to become a team member gave people the chance to claim they did not have the time due to other work commitments.

However, this situation will occur when the process stage relies on people volunteering to become members of improvement teams. Imposing team membership on such individuals, would be counterproductive, as past practice within the organisation has proved.

While the theoretical stance of stage-2 is that a team consists of volunteers, in practice it is sometimes not possible to maintain this 'volunteer only' status. In some instances, the situation of concern requires specialist knowledge or abilities that require some invited individuals to join the team. Nonetheless, to maintain the volunteer principle such individuals must have the option to contribute only when their participation is essential to the team's ongoing work. This situation arose in the 'Lung Demand Valve' case studies given earlier. The team required an individual to conduct statistical analysis on samples of products manufactured to various surface finishes. In that instance, a request to an industrial engineer who had not volunteered to join the team to conduct statistical analysis became essential. Hence, in order to maintain voluntary team membership, he attended meetings only to discuss his findings on the various tests carried out. Allowing the volunteer team members to draw conclusions and plan activities from the information he supplied.

A SOIP team requires harmonious relationships in order to develop the underlying principle of understandings of others situational understanding. Relationships are dependent on individual personalities. Some people can accept other's ideas will differ from their own without difficulty or feeling personally threatened, while others may become defensive and adversarial. The one process failure during development was due to the managing director's insistence on the management team using the process. The team was not one of volunteers, but made up of departmental directors instructed to take part. To compound the issue, and move away from process principles the team selected a theoretical improvement situation. As a result, the team simply followed the managing

directors bidding, as was the practice with PSP teams. Therefore, second order understanding was stifled, and did not have the opportunity to develop. In contrast, the team conducting the highly successful implementation of the model during the development of the 'Time and Attendance' system described previously consisted entirely of volunteers. Team members were from the initial meeting, willing to exchange ideas and listen to the opinions of others. For that reason, second order understanding formed naturally.

7.2.3 Stage 3: Explore Differing Understandings and Worldviews

Stage-3 begins with a team of individuals who have an interest in the issue at the centre of the improvement activity. At this point, it should be emphasised by whoever is acting as the improvement process facilitator, that the stage has the purpose of exploring the worldviews in relation to individual perceived issues and concerns. Again, the word 'conceived' indicates that the stage aims to begin by the development of understanding, the fusion of the other team members' views and the way they understand the issue.

The experience of individuals involved with improvement activities up to the introduction of the SOAP had been to conduct improvement meetings in an environment of debate. Abandoning this practice, and accepting several interpretations of the situation as having equal merit proved extremely difficult. This was an anticipated situation, to think people could simply change the way they conduct meetings without difficulty, would have been a naive assumption. As a result, teams required reminding on several occasions that stage-3 identifies a number of interpretations of the issues and events under review. Debate eventually gave way to dialogue, and teams began to trust and exchange their thoughts freely. The concept of several versions of the important issues existed with regard to a situation, dependant on the point of view of the individuals concerned, became accepted as the norm for the SOIP. People when asked to discuss the change brought about by stage-3

agreed that while they found it difficult, the move to dialogue allowed understandings to develop with regard to the point of view of other team members.

The ability of stage-3 to bring to the surface multiple viewpoints, underlines the need for stage-2 team selection; incorrect team formation will hinder stage-3 exploration. Debate will rule, if people are unable or unwilling to consider opinions that differ from their own. During this stage, if the dynamic appears that some individuals are attempting to dominate or pressurise other team members, then the process facilitator's role is there to restore balance and dialogue. If it is not possible to restore a dialogical approach, the team should disband and the process returned to stage-2 by the facilitator.

7.2.4 Stage 4: Analyse Multiple Perspectives; to Outline Themes; Define System Boundary

Stage-4 builds on the emergent stage-3 understanding, analysing the multiple perspectives to outlining themes and systems affected by and affecting the situation of interest. The improvement teams found this a difficult but rewarding stage of the model. People saw this stage as the opening of stage-3 perspectives and understandings, into organisational practicalities. In the case of the 'Lung Demand Valve', this initially manifested itself in the nature of the dialogue surrounding the tests required to identify the causes of the problem. The first challenge the teams encountered, was to define the extent of the people, departments or organisations affected by the situation of concern. To do so the team found it beneficial to begin to think of the way the various systems interact and interrelate. This was the 'Lung Demand Valve teams' dilemma, because for years the problem had been associated with lever height setting. Yet identification of lever height as the root cause of the problem occurred on previous occasions, investigations were carried out and actions taken only for the problem to reoccur again. Hence, looking at lever height setting in isolation had proven not to deliver a sustainable resolution to the problem. Consequently, the team concluded that while lever height may be a contributing factor, it was unlikely to

be the only factor influencing the situation. Using the SOIP allowed this researcher to encourage the team to examine the problem from perspectives never previously examined. This did not come easily to some members of the team, especially as the team had initially intended to follow the traditional route of the PSP. Nevertheless, the SOIP allowed the team to develop the systems definition that subsequently enabled the team to arrive at a permanent solution to the 'Lung Demand Valve' situation.

In contrast to the difficulties encountered by the 'Lung Demand Valve' team, the 'Time and Attendance' team found stage-4 relatively simple. The system and its boundary were readily identifiable. The team did not have pressure to solve a problem that could possibly have far-reaching consequences for the organisation. However, ethical concerns did exist with the case that did not exist with the LDV case. The question of the management using the team to develop a system only possibly required by legislation did arise. Consequently the question arose, 'was the proposed legislation change an excuse for management to bring in a clocking in system? After some discussion the team concluded that, management intended to introduce a 'Time and Attendance System' regardless of whether the proposals were put into place or not. This consideration of the underlying reasons for the management's request was a complete alternative to tradition, where teams carry out the task without question. Nevertheless, the dialogue between team members had come to the understanding that, it was in the interests of the workforce for the team to carry on with the development and implementation of a system with as few changes to accepted norms as possible

As the cases reveal, the complexities encountered in stage-4, vary with the situation. As situational complexity increases, then likewise, the difficulty in establishing the first and second order boundaries of the system or systems involved increases. Whatever the case, the teams found stage-4 the key stage in coming to understand the systems involved and

their interaction with each other. For example, the tests carried out on the components of the LDV developed understanding of their interaction with each other. Consequently, participatory observations of stage-4 has indicated, this stage requires considerable discussion when outlining the underlying themes and defining the first and second order system boundaries

As stage-4 moves towards stage-5, the second order boundary from stage-4 indicate the individuals, groups, departments, suppliers and customers that could be included in the wider dialogue of stage-5.

7.2.5 Stage 5: Initiate Dialogue around Emergent Themes; Gain a Wider Understanding of Mental Models

Stage-5 carries on from stage-4 in developing a deeper and wider understanding through opening the process and consequently dialogue to the widest possible audience within the second order boundary. The literature tells us that stage-5, should sweep in as much information and opinion as possible (Churchman, 1970, 1979) and while this is the ideal situation, at times, as with the LDV case study just not practically possible, due to the number of actors involved. As a result, in many instances stage-5 must follow the advice of Ulrich (1993), who correctly states that circumstances may require limits to be imposed on actor involvement. As a result, teams entering stage-5 must examine the second order boundary established within stage-4, in order to determine the extent of the actors involved. Such examination may result, as was the case with the 'LDV, in second order boundary redefinition, to be able as Ulrich (1993) points out "*make analysis possible in practical terms*". On the other hand, as with the Time and Attendance case, it is possible to follow Churchman's (1970, 1979) advice and include all those affected.

During the process trials, this stage, in most instances, brought the teams into new realms of thought, when facing questions not normally encountered within traditional

organisational improvement processes, such as the PSP used by the company. Questions became the key to new knowledge, such as; how to include those affected in the dialogical process of the stage. How was the team to communicate their understanding to the wider audience? How was that audience to feed back their opinions thoughts impressions or objections to the team? These and many more questions arose because of the stage-5 requirement to include the largest practical number of actors in the creation of the widest possible understanding. In some instances, improvement teams used questionnaires, in others meetings with individuals as well as customer and supplier representatives. Some teams utilised the company weekly team briefing sessions to discuss the issues involved. Most used a combination of methods to communicate with and receive feedback from the actors concerned. Stage-5 proved to be an externally flexible stage, with no set rules covering how to reach the wider audiences. Teams chose and adapted methods that best suited the particular set of actors they wished to reach. In all observed cases, the teams gained a wider understanding of the situation and as a result updated their initial conception of the situational issues

Once stage-5 has enabled the team to gain the widest understanding possible, it then becomes the role of stage-6 to define the systems language to be used,

7.2.6 Stage 6: Co-create Meaning and Evolve the Language addressing the Situation of Concern

In most instances, stage-6 meaning and language development commenced from a language already in use within the organisation. As with most if not all organisations, Northumberland Manufacturing had unintentionally developed an organisational terminology and language, suited to the functions and processes carried out within the departments of the organisation. For Northumberland Manufacturing, this language was departmental, with each department referring to the same phenomenon in slightly different

terms. The function of stage-6 is to develop such organisational or departmental language variations into one language, in which shared meaning extends across all the actors involved in the use of that language, irrespective of department boundaries. With the majority of the teams, language development had commenced during the dialogue conducted within stages 4 and 5. Team members questioned other members on the meaning of some of their departmental terminology, asking them to explain, clarify and expand on terms they did not understand. Communication from the teams to the wider audience utilised glossaries of terms whenever a team felt it desirable. This was most certainly the case when expanding the understanding of the various components of the 'Time and Attendance' system to the workforce.

Stage-6 is in most cases a short stage, as the establishment of language and meaning has developed during previous stages, nonetheless this gives the opportunity of consolidation of meaning. Improvement teams were able to take a step back, and examine the language commonly used, altering and enhancing that language to clarify the systems meaning. Eliminating, to as large an extent as possible, misunderstandings arising from ambiguous or duplicate terms, that had differing interpretations for differing sections of those involved. In the cases observed, teams moved quickly through stage 6. Using the stage more as an opportunity to recap and clarify the meanings developed during stages 4 and 5 before moving on to stage-7, the final stage of the process.

7.2.7 Stage 7: Facilitate Emergence of Infrastructure to Improve the Situation

Stage-7 should be viewed as the final stage of the process, or more correctly the final stage of an iteration of the process. Stage-7 has the function of facilitating the environment capable of supporting sustainable change. For organisational improvement teams, this can mean many things. For some, stage-7 is the implementation by the team of plans developed in previous stages. In other instances, it may require the formation of a team

dedicated to the implementation of processes and procedures developed. Whatever the circumstances, building the environment of change is the important factor. For the Time and Attendance system, this entailed building trust amongst the workforce that, the system would not be used to the determent of employees. In order to achieve this trust, the team requested management to give an undertaking to the workforce that the system would not be a used as a disciplinary tool, but as stated, used to ensure no member of staff inadvertently infringed the working time directive rules. As the management happily complied with this request, the team passed on the assurance through the media of the weekly team brief. When asked why use the weekly brief, the team reasoning was that as the brief originated from senior management and was passed down through the company management structure with senior managers briefing junior managers, until it reached operator level. No manager or group of departmental managers could claim to be unaware of the stated and agreed use of the system. This was an indication of the team's misgivings with regard to the underlying perhaps hidden management agenda with regard to the introduction of the system. Nevertheless, the team did facilitate the infrastructure that allowed the successful introduction of the Time and Attendance System as described in the case study.

In the case of the LDV, as the case study describes, development of the infrastructure for change began immediately. The team quickly concluded that stage-5 initiation affecting customers must begin at the earliest opportunity, thereby include them in subsequent decisions and begin stage-7 infrastructure facilitation as soon as possible. This case proved to be one where the flexibility of the SOIP process proved vital to bringing about change. Several of the process stages used especially stages 5 and 7, were not only out of sequence but also in a continuous manner from the beginning allowed the team to achieve a satisfactory solution.

7.3 SUMMARY

From the participative observations made it can be stated that the infrastructures facilitated by the various teams provided the platforms required for the organisational change required to implement the various improvements. For the Time and Attendance team this meant the building of an acceptance of the system, while for the LDV it required rebuilding customer confidence in the product. Other teams needed to facilitate an atmosphere of cooperation with external organisations, to enable their staff to communicate and work with Northumberland Manufacturing personnel. In all but the one instance of the senior management team, the infrastructure of change developed by the various SOIP teams proved an extremely effective method of producing and implementing sustainable solutions to situations of concern. In the case of the senior management team, the basic principles of volunteer teams, along with actual rather than theoretical situations forming the issue of concern were ignored The process has proved successful as an alternative and superior organisational improvement process to that used traditionally within Northumberland Manufacturing. Practical examples of this are found in the implemented and functioning of the Time and Attendance System. Restoration of customer confidence with regard to the LDV, and a new understanding developed of the underlying reasons for the constant flow problem. Corrective actions evolving from that understanding, has permanently eliminated this potentially disastrous problem. The SOIP trials have shown a degree of flexibility and adaptability that has allowed its use in situations covering all aspects of organisational activity from clerical issues through to manufacturing problems.

8 CHAPTER 8: SECOND ORDER PROCESS ANALYSIS AND COMPARISON

This chapter analyses the use of the SOIP and also compares the similarities of the SOIP with other improvement processes in use. The process compared will be Soft Systems Methodology (SSM), and The Deming Wheel (PDCA), as used in the Kaizen improvement process. The named processes, are well proven and used organisational improvement process that move some way towards but do not fully embrace the second order improvement philosophy.

8.1 THE DIFFERENCE OF THE SOIP AND OTHER PROCESSES

The SOIP has as its priority, the development of an understanding the views of other individuals. This is the primary differentiating factor of the process. While other processes such as the PSP, totally ignore understanding of the views of involved individuals, others such as SSM, seek to establish a consensus of views with and agreed single worldview (Checkland & Scholes, 1998). In the same way, the PDCA and Kaizen both seek consensus amongst the improvement team. Only the SOIP puts the views of people and exploration of the differences between those views at the centre of the improvement process.

8.2 BASIC SOIP QUESTIONS

The SOIP process has some generalities that apply irrespective of the organisation in which the system was developed. These generalities require exploration and reflection. Therefore, a selection of general process questions undergoes exploration below:

1. What type of social environment is required to implement the SOIP?
2. Is specialist or academic knowledge required to use the process?
3. What type of issues and situations can be addressed with the process?
4. In what circumstances will the process fail to develop second order understanding?
5. Is it possible to implement the process in non-production environments?
6. How adaptable is the process?

8.2.1 The Social Environment Required for Second Order Improvement

The 'SOIP does require a particular social environment to allow its implementation and operation. Overall, the culture should be flexible: one that allows individuals to express themselves without fear of reprisal. An environment that allows the sharing of ideas and the recognition of others' abilities feelings and aspirations is the foundation of the SOIP. During trials, the issue of trust and allowing others to voice their opinions without reprisal proved vital.

8.2.2 Knowledge Requirements for Process Implementation and Use

A primary aim of this research was the development of a second order improvement process that did not require academic or specialist input in order to be utilised.

However, this researcher acting as a team member, as well as an observer, concluded that a small amount of 'systems thinking' knowledge was essential to process utilisation. The team facilitator must have, as a minimum, a working knowledge of systems thinking to be able to advise the team and be able to define and distinguish between first and second order boundaries. Nonetheless, individuals who are concerned with organisational improvement on a regular basis, soon grasp that the first order boundary refers to factual data, number of operators, types of material or information processes etc and physical locations of machinery, computers, and material storage. The 'second order' boundary refers to the people, groups, and other processes even other organisations that change will influence. In practice, once people became aware of the first and 'second order' aspects of a system, first order physicality and 'second order' influences on people and groups, systems thinking follows naturally.

The process requires a small amount of academic systems and second order knowledge, from at least one of the team members, who is able to act as the process facilitator. Yet

when implemented and used, the process grows systems thinking knowledge. Team members not only gain knowledge of the system or systems affected by the situation of concern. They develop an understanding of how the elements of the systems interrelate and interact with one another

8.2.3 Issues and Situations Addressed by the Process

While it is possible to utilise the system to address any issue of concern some are more suitable than others. If some issues are more suitable, the question becomes, what situational attributes make one situation of concern more applicable to the SOIP than others do? Considering the stages of the process, stage-3 deals with developing an understanding of the views and opinions of other team members. Stage-4 analyses the multiple perspectives of a situation from the worldviews of the team members. During the stage-4 analysis, system boundaries agreed by the team emerge. Additionally stage-4 develops a set of themes relative to the issues held commonly or by at least the majority of the team. Stage-5 then utilises dialogue to extend the agreements of the improvement team to the wider world of the people affected by the systems of the situation under investigation. These three stages all concern the exchange of individuals' views opinions and thought on the situation. Checkland (1981) has described such issues as 'messy' situations where the problem or circumstance is 'little understood, ill defined and characterised by their complexity, in terms of cause, consequence and social context'. The 'SOIP organisational improvement process most suitably addresses these situations.

8.2.4 Can the Process Fail to Develop Second Order Understanding?

As has already been described, the process can fail to develop second order understanding, therefore the short answer to this question must be 'yes'. All the same, the circumstances surrounding failure to develop second order understanding detailed previously did occur. The process can only function when the social environment allows individuals to express themselves freely, without fear of retribution. Individuals within improvement teams must

treat each other with respect and integrity. Team members must be confident that thoughts and ideas expressed during dialogical meetings would remain confidential: not repeated out of context to non-team members. In short, development of second order understanding requires a social environment of trust, and mutual respect amongst team members. This in turn requires an open forward thinking organisational environment that is respectful of individuals' views. This does not mean to say, that in using of the process, organisations cannot have clear goals and targets with a planned and implemented strategy. On the contrary, second order understanding will flourish in such environments. As long as people have freedom to decide how goals are achieved, use of the process will develop second order understanding.

8.2.5 Process Implementation in Non Production Environments

From conception, the intention of the SOIP was that of a generic improvement process, capable of implementation in any organisation possessing the required social environment. The process views organisations as a collection of interrelated and interdependent systems. No matter what the purposes of the organisation, or to what sector it belongs, it remains a collection of interdependent systems. Looked at from a systemic perspective organisations will have common attributes. They have a purpose, the reason for the organisation's continued existence, the means of carrying out that purpose, manufacturing capabilities, service facilities, sales and marketing departments, customer care, human resources and many other departments working together to bring about the continuation of the organisations reason for existing. As a result, an organisational improvement process based on improvement at a systems level, such as the 'SOIP' is applicable to any organisation.

8.2.6 How Adaptable is the Process?

The preceding sections show the process is applicable to any organisational situation. Furthermore, the process has the capability, as the LDV instance demonstrates, for the

stages to be carried out, commenced and completed in the order and time frame best suited to the situation being addressed. These two attributes, have been the contributing factors to the successful application and adoption of the system by those individuals who have taken part in the process trials. The case studies demonstrate the achievement of adaptability as borne out by the simultaneous use of stages during the LDV improvement case. Process stages in the majority of instances, will follow the sequence shown in the process model. However, when circumstances demand, it is possible for the improvement team to select the order and duration of the process stages, thereby adapting to the prevailing needs of the situation. Flexibility and adaptability are built into the process, thus one of its greatest advantages is the capability of being used it in ways that suit the situation. Considering the PSP expects the situation to be adapted to the process, the individuals utilising the 'second order' process found the adaptability of the process to the situation a significant advantage.

8.3 SOIP COMPARISON WITH OTHER IMPROVEMENT PROCESS

Authors, such as Easton and Jarrell (1998) and Keating et al, (1999) maintain that imposition of externally purchased improvement processes seldom if ever works. Nevertheless, many organisations have implemented organisational improvement processes, such as Kaizen successfully.

8.3.1 Soft Systems Methodology (SSM)

SSM was developed by Professor Peter Checkland and publicised in 1981 in "Systems Thinking Systems Practice". Following thirty years of research into the application of Soft Systems Methodology, Cordoba and Farquharson (2008) consider early applications to be a set of "*scientific disciplines and knowledge generated by the scholarly community*". This conclusion removes SSM from the area of 'second order understanding'. Nevertheless, SSM has moved in the direction of a second order approach in latter years. Cordoba and Farquharson (2008) make the comment that recent applications of SSM are *"knowledge production activities, mainly trans-disciplinary and socially accountable in its*

application". While this could be described as second order, this process still excludes 'understanding of others understanding'. When describing the application of SSM, Checkland and Scholes (1998) and Armson (2003) use debate as part of the CATWOE mnemonic to come to an agreed conscientious not an understanding of 'other's understanding'.

The use SSM has been applied in various fields, Seddon (2008), has described its use in the public sector while Somerville & Howard (2008) uses the method to advance workplace information.

Nevertheless, SSM has moved towards second order understanding, it still relies on agreed consensus. Basden and Wood-Harper (2006) discussing SSM comment, that it does not work as well as it might and has a tendency to result in conventional and regulatory proposals, rather than radical proposals for change. In contrast, the SOIP seeks to move towards radical change through understanding gained from dialogue and the exploration of differences not similarities.

8.3.2 Kaizen

The Deming wheel PDCA, found in Kaizen as the central method of planning implementing and validating future activities, is the basis of the Kaizen improvement process (Grubb, 2008). Kaizen has been applied in many situations; examples are in healthcare by Wennecke (2008) and in manufacturing by Ortiz (2008). Toyota used the system in the development work of their formula one racing car as reported by an unknown author in the March (2008) edition of 'Metalworking Production'. However, in all three cases the impetus was the establishment of a consensus on the situation and the carrying out of an improvement action plan. Thus, these implementations remain predominantly first order, examining the data and hardware of first order system boundaries. While Wennecke (2008) and Ortiz (2008) both speak of the challenges faced when implementing

Kaizen, neither mention understanding others understanding of the situation as part of the process. Ortiz (2008) takes into account operator's opinion. It is mentioned almost as an afterthought when discussing the implementation of lean manufacturing utilising a Kaizen approach. It appears that this author has forgotten the Kaizen Buddhist philosophy of 'harm to none and improvement for all'. The SOIP holds this Buddhist philosophical view as one of its underlying philosophical driving principles. The SOIP has people at its heart, and the improvement of situations to the benefit of the people as it primary driver.

Using Kaizen as a second order process has been attempted by Neese and Siew (2007) however, even these authors do not mention, or attempt to achieve the understanding of others understanding requirement of the SOIP. They only quote three fundamental requirements, which are management and shop-floor synergy, process and results. These are implemented by creating a holistic process to a problem, brainstorming and action to see if an idea would work. This approach gives everyone an opportunity to visually see the problem and try solutions. It moves a little closer to a second order understanding approach but still fails to require understanding of others.

In conclusion, Kaizen can be classed as a second order approach that considers people. Nevertheless, it stops short of requiring the participants to concentrate on others understanding. The SOIP explores these different worldviews, arriving at an understanding of others that allows action acceptable, supported and agreeable to all the actors affected.

8.4 SUMMARY

This chapter has examined other improvement processes, which at first sight resemble the SOIP. However, examination of the literature surrounding the application of both SSM and Kaizen, reveals that these processes have a radically differing method of coming to agreement. Both use debate and consensus, which for second order understanding are

inadequate. The SOIP requires an understanding of how others see the world. Such understanding is achieved only through a dialogical exchange of opinions.

Improvement process such as SSM and Kaizen ignore the differences in opinion, concentrating on similarities. The second order improvement process has the distinction of using the examination of the differences of opinion to understand how and why others see the world the way they do.

9 CHAPTER 9: CONCLUSION

The question under consideration within this research has been, "*how can 'second order' practices be used in enhancing the process of organisational quality improvement*". In considering how this question originated, through examination of the primary research indicating that Northumberland Manufacturing lacked an organisational improvement process accepted by the workforce. Yet, at the same time, answers to primary analysis questionnaires made clear that the majority of the staff considers working with fellow members of the organisation enjoyable thereby indicating a willingness, on behalf of the staff, to take part in groups working together to attain agreed goals.

In order to fulfil the generic flexible and adaptable intention, the SOIP combines the cyclical structure of the PDCA cycle with the philosophical belief of 'benefit all and harm to none' from the Kaizen philosophy. On a personal level, the process has the aim of increasing, self-direction, personal development and communications. Added to this mix is the necessity for individuals to realise that theirs is not the only way to view a situation. Understanding how others view the same phenomenon enhances self-awareness. Awareness and understanding, of the differentiation between other people and oneself is the second order element and distinguishing philosophical feature of the process.

The SOIP was developed using a series of SOIP implementations with this researcher acting as a participative observer. The individuals taking part selected the applications used to develop the process. This ensured that the workforce envisaged the process not as an academic exercise, but as a working improvement process. The process of application observation and amendment resulted in the process shown as figure 6. In its present form, the process has fulfilled the research objectives forming a working model of a second order understanding organisational improvement system.

9.1 WHO CAN USE THE SECOND ORDER PROCESS

The intended users of the process are organisational members of staff. As envisaged, staff members of organisation would use the process without the involvement of academics or consultants. As a result, organisational continued improvement is undertaken not by academics or consultants, but by the individuals of the organisation. This in house driven application of the process is the intended method of use. However, this does not preclude the process use in other situations. For example in group dynamics research, the process stages can be used alongside Bruce Tuchman's originally 4 later extended to 5 stage model (Smith, 2005). Stage-2 and the early into stage-3 of the 'second order' process model coincide with Tucumán's Forming phase. In this phase, the group comes together and begins to form relationships. Stage-3, 4 and 5 will develop the storming and Norming phases. These phases develop the roles of the individuals within the group, and identify the aims of the group and roles of the members in attaining those aims. Finally, the Performing phase of Tucumán's model, where performance of agreed actions takes place, is studied within stages 6 and 7 of the second order process. As a result, academic study of group dynamics and relationship formation is possible using the process. Alternatively, in consultancy mode, the process implementation as a tool to build understanding within an organisation is possible. In this mode, the process is used to influence mindsets and give new perspectives to ways of envisaging situations to organisational members.

Thus, in addition to the process being used directly by the staff of organisations for organisational improvement, it can be utilised by academics conducting group research and consultants to introduce systems thinking and 'second order' principles to an organisation.

9.2 THE CONTRIBUTION TO KNOWLEDGE

The research has contributed to knowledge in several ways. The process developed from theory, then applied in practical situation examines the correlation between theory and practice. The process developed a second order approach, that put the emphasis on the understanding of others points of view. In contrast to other approaches, this approach seeks to identify and understand the reasons for the differences in worldviews instead of attempting to use the similarities to come to a consensus. Thus, the process has filled a gap in the organisational improvement body of knowledge in the area of second order approaches. In addition to organisational improvement applications, the process has uses in academic research into group dynamics and relationship formation. The two case studies developed during the research bring an insight into the implementation and operation of the process.

9.3 FUTURE DEVELOPMENT: WHAT COULD BE DONE NEXT

One final consideration is the future development of the process. The current stage of the process answers the objectives of the research. It is capable of implementation by an organisation to provide a sustainable improvement process. On the other hand, like most other processes, it is capable of further refinement and improvement. However, that is for future research. Other researchers may add or remove stages to the process model in light of their experiences in its use. Nevertheless, this researcher believes that the underlying principles of the approach will not change over time. On the other hand, if any attempt is made to deviate from the underlying 'second order' cooperative theme of the process then the process reverts to 'first order'.

However, development can take place especially for dedicated use in the research of group dynamics. The process has been developed in a manufacturing environment and while functioning satisfactorily in a clerical atmosphere, implementing the process in other sectors such as the education, finance or health would be an interesting prospect.

Whichever direction future research or process implementation takes it is this researcher's belief that 'second order' improvement processes, such as the one developed, are the way forward. If organisations are committed to cooperative employee led continued organisational improvement then the move from PSP type first order to 'second order' SOIP process must be made.

The research has developed a process, which successfully embeds second order and systems thinking practices into organisational improvement. The process builds on a 'Systems Thinking' approach with an emphasis on the 'understanding' of the views of the individuals involved. Implementation is possible in any organisation that enjoys an open trusting environment, irrespective of the operational sector. The major contribution of the process is in the change of emphasis from debate to dialogue as the underlying method of communication in the improvement process. This move to dialogue constructs a framework for the greater understanding of others' understanding within an organisation in general.

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11 APPENDIX A, A SELECTION OF PUBLISHED PAPERS

Appendix A contains published papers covering the development of the Second Order Process. The appendix begins with a listing of the paper tiles, year of publication and the conference etc where the paper was presented. In all cases the papers authors have been have been given.

Conferences and Journal Papers

Brown J, Sice P (2006), Using Second Order Understanding in Organisational Improvement, UKSS conference September 2006 & Systemist V28(2)

Brown J, Sice P, Weir D (2005), A Second-order Process for Organisational Improvement Presented by Jim Brown at the Practicing Philosophy of Management Conference July 2005 Oxford, & European Business School Web Site as a Working Paper.

Brown J and Sice P (2005) "Towards a Second Order Research Methodology" The Electronic Journal of Business Research Methodology Volume 3 Issue 1, pp 25-36, available online at www.ejbrm.com

Brown J., Sice P. (2004): An Autopoietic Perspective into Cognition and Language in Social Systems Research: A Study of Quality Enquiry At Draeger Safety UK, European Conference on Research Method, April 2004 Reading

Brown J. (2004): Lifting the Barriers to Innovation, A paper by Jim Brown presented at the IT Innovation Conference, Intel Ireland Lexlip June 2004, Also Published in the book, IT Innovation for Adaptability and Competitiveness, Edited By Brian Fitzgerald and Eleanor Wynn

Brown J., Sice P. (2004): Towards a Participative 'Second Order Research Design: Consultancy and Research Experiences at Draeger Safety UK, A Paper by Jim Brown and Petia Sice presented Jointly by Jim Brown and Petia Sice at the United Kingdom Systems Society Conference September 2004 Oxford

Brown J., Sice P. (2003): A Knowledge Management Approach To Reducing The Cost Of Poor Quality – The Draeger Case, Presented by Jim Brown at the United Kingdom Information Society Conference Warwick 2003

USING SECOND ORDER UNDERSTANDING IN ORGANISATIONAL IMPROVEMENT

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Abstract

The organisational improvement process is often formally specified as the 'problem solving process, of the adopted quality management model. Such a process looks to understand the problem but not the people involved in that problem and the effect differing understandings can and will have. We term this perspective a 'first order understanding'.

This paper looks at the 'first order' perspective normally adopted in organisations and explores the potential of applying 'second order understanding' and 'systems thinking' to the process of organisational improvement. We do not argue that 'first order' improvement does not have a place. However, when people become involved in any process, 'second order' or understanding of other peoples understanding is required.

A generic model of a process of improvement taking into account 'second order understanding' principles has been developed. This paper describes the proposed model and reflects on experiences of implementing it in practice.

Keywords:

second order understanding, social systems, systems thinking, autopoiesis, language, dialogue

Introduction

Organisations speak of organisational improvement, choosing one or other 'total quality management' models as the basis for improvement actions. However, the improvement methods advocated by these models are normally of the 'first order understanding' variety, such as the problem solving process found within the 'European Foundation for Quality Management' model (EFQM). Such models look to understand a problem, but not the people involved in that problem and the effect differing understandings can and will have. If we are to fully understand problem situations and treat them as opportunities to improve, we must not only understand the nature of the problem but also understand the understanding other people have of the same situation. One of the first things we must come to understand is that an organisation does not have to wait for a problem to occur before organisational improvement activities can take place. On the contrary, organisational improvement should be an ongoing, part of everyday activities, carried out

by the entire workforce and engrained into the fabric of the organisation. This requires 'second order understanding' and a realisation that our worldview, our interpretation of events, is exactly that, only our interpretation.
It is not the only perspective; the perspective held by other people is just as valid. Understanding the thinking behind those other perspectives, and why people see events as they do, is the focus of 'second-order understanding'.

Organisational Improvement and the Problem Solving Process (PSP)

Today most organisations use frameworks, such as the EFQM model, with the view that quality is the responsibility of the entire organisation. The main improvement tool of such frameworks is the Problem Solving Process (PSP). The name immediately gives rise to the assumption; the organisation must have a problem before the process is used. After all, it is entitled the problem solving process, is it not? We need to get away from this assumption and develop a tool that is an improvement tool used at any time, not a problem-solving tool only used when we have a problem.

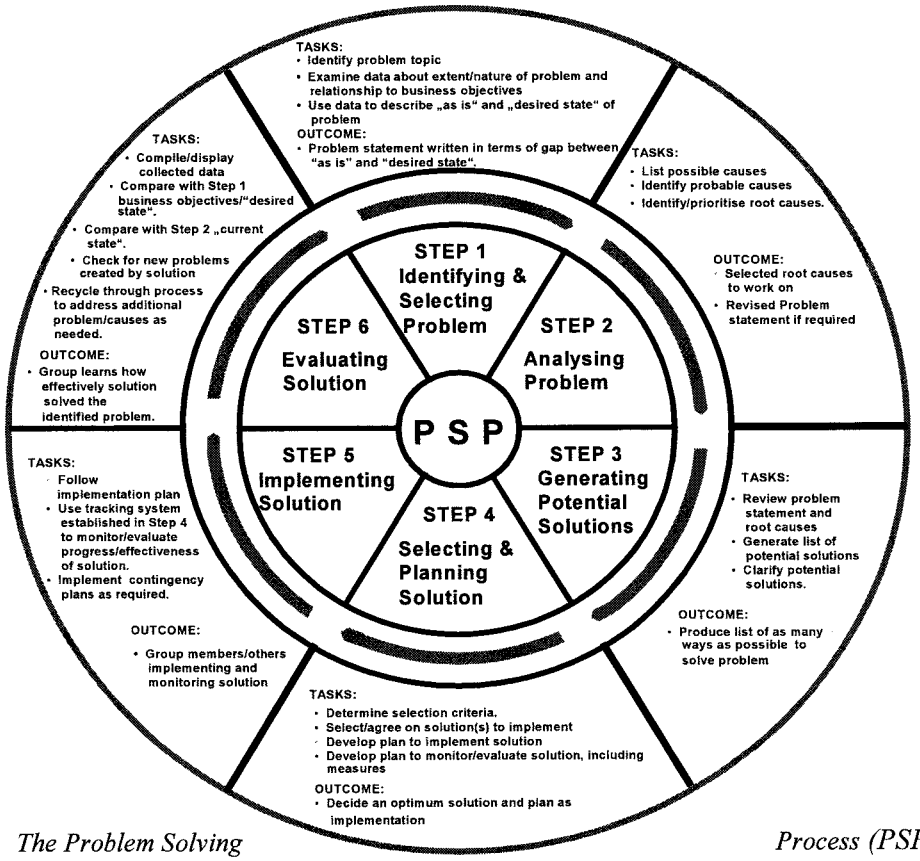

Figure 1. The Problem Solving Process (PSP)

Additionally the PSP (Figure 1) is a closely ordered systematic procedure. The six steps are carried out in sequential order, with outputs from one becoming inputs to the next. This is clearly an 'objective' enquiry, i.e. 'first order understanding', examining what are seen as undisputable facts. Synergy of multiple worldviews, engaging in understanding of others' understanding, i.e. 'second order understanding', does not enter into consideration and thus, is not included in analysing the situation.

This reductionist, subject/object dualistic approach, is typical of the manufacturing sector. For example, one of the first steps of the PSP is to define the root cause of the problem. No contemplation of the possibility that the problem may have many levels or contributing

factors acting in unison is considered. A common problem with the root cause philosophy is that it is linear, and has difficulty handling feedback and iteration.

The PSP while useful for first order applications not involving people has drawbacks that a 'second order understanding' approach can overcome when people become involved. Second order requires, in fact demands, that we first ask how others perceive a situation. Why do others have differing perceptions of the same phenomena? What commonality exists? What are the major differences that could cause problems or friction within an improvement team? What are the agendas of the team members are they compatible or at odds with each other, etc.? Second order compels us to look under the skin of a situation to the underlying assumptions and prejudices of the people, who are the actors within the situation under investigation.

Second Order Understanding

Our approach revolves around two fundamental themes. The first is the constructionist belief that as human beings we are all unique. Our uniqueness stems from our experiences of life, and shapes our view of the world we inhabit (Depraz, Varela, & Vermersch, 2003), (Crotty, 1998).

As we journey through life, we encounter events, experiencing the rich and varied phenomena of everyday living, as well as the observations we make as researchers. We are guided and influenced by parents, teachers, friends, and colleagues. At first as young children, our view of the world is limited to our immediate surroundings and family. As we grow and learn, our view of the world becomes more complex, enriching the mental models we construct of the world around us.

Our experiences and beliefs bring forth our world, our view of reality from within ourselves (Smith, 2003). We fit the events we witness into our own personal reality. Amending our worldview and building on experiences. As individuals, we all have a unique set of experiences, beliefs, influences and prejudices. As no two people have the same set of experiences, no two people will have the same view of reality. Our own personal view of reality may be similar to that of many other people, but it will never be identical. It is also incomplete, how can we build models from experiences we have never had; or understand phenomena we have never encountered. However incomplete or different from other people, we can only use our own worldview to interpret events; we have no other way of understanding the world around us.

> *'Understanding and experience form a unity that nobody can knowingly act against' (Krippendorff, 1993).*

This incomplete individual interpretation of reality is the everyday understanding of the world we accept without question. It constitutes 'first order understanding' (Krippendorff , 1997).

However, if we want to gain as full an understanding as possible, of others and ourselves, we must look deeper than simply accepting our own view of reality without question and explore our underlying beliefs and ask why we hold the views we do. We begin to develop the understanding of our understanding. This process of exploring why other people hold the views they do is also necessary in understanding the understanding of others. What is required is 'second-order understanding', which put simply is the 'understanding of understanding'.

Krippendorff (1993, 1995, 1996, 1997), defines 'second-order understanding' as the "understanding of others' understanding including self understanding". He maintains that 'second-order understanding' is developed through communication arising in language. We must become interactively involved with those we wish to understand. Taking other peoples cognitive autonomy as least as seriously as we take our own, not merely observing but participating. 'Second-order understanding' has dimensions, not reached using first order alone.

> *"'second-order understanding' is a way of knowing wholly different from ordinary (first order) understanding of things" (Krippendorff, 1995).*

While Krippendorff uses the term 'second-order understanding' to mean 'understanding of understanding', other writers such as Derek Hodson (2002) with slightly different but still applicable meaning, have also used it. He writes:

> *"The approach I am seeking does not equate understanding with belief, nor does it seek to displace other world views with the approved scientific view. Rather it seeks to equip students with the knowledge, self-knowledge and confidence to move freely between differing worldviews accepting each on its own terms and for its own purpose" (Hodson, 2002).*

Hodson's version of second order understanding stresses the personal knowledge aspect of understanding. This is looking at oneself and understanding the application of personal knowledge. Hodson looks to understand the purpose of other worldviews, applying each worldview to a specific circumstance, moving between worldviews as circumstances dictate.

Krippendorff delves much deeper than Hodson into 'understanding of understanding'. If we are to engage meaningfully with others, we must understand them. We need to know not only what they think is important, but why they think it is important. Why people hold the views, they do. What shapes their thoughts into the world they perceive? We are not able to leave our world and move into another. The worldview we create is part of our being. It is our way of making sense of what happens around us, our way of interpreting events. We cannot leave our world; we must continually recreate it through deeper understanding of not only our world, but also the world of others (Krippendorff, 1993). To stop short of Krippendorff's 'second-order understanding', only trying to understand ourselves denies us this deeper understanding of others.

The only way we can experience the world is through ourselves. Maturana & Varela (1987) argue that, the phenomenon of knowing cannot be taken as 'facts' or objects out there, we grasp and store in our mind. The experience of anything out there is validated in a special way by the human structure. Facts, information and knowledge are not objective characteristics of the world. They arise in the interaction between the human observer (as an autonomous system) and the world (environment). Our enactment of the world constitutes our knowledge (our reality). Thus, there are no identical cognitive realities. Observers perceive different 'realities'. The understanding of someone's understanding is always a personal understanding of someone else's understanding.

As humans, we use systems as a way of explaining the world around us. We envisage the world as an interrelated set of systems working together to deliver stability in an ever changing chaotic environment. Our world as human beings is a systemic world, a world

we cannot escape, and therefore to improve we must strive to understand. It is thus important to consider the meanings, use and implications of a systems language.

Systems, Epistemology and Language

While each individual sees the world differently, there are similarities in worldviews and the way we as human beings interpret and understand the events taking place around us. For example, the law of gravity works in the same way for all of us; it is taken for granted, and therefore modelled within our worldview that if we drop something as long as it is heavier than air it will fall to the ground. Our worldviews do have constants or laws that are applicable to all situations. We do not argue that such laws do not exist. However, the concept of a system is a creation of the mind and as such is open to interpretation, giving, purpose, area of influence and significance by the individual observing that system.

As humans, we see the world as a complex set of systems each fitting into our picture of reality. The world is understood in relation to systems (Beer, 1981, 2000). In epistemological terms, the world is a collection of interrelated, interdependent and recursively embedded systems (Umpleby, 2001a, 2001b).
Whenever a group of people come together within an organisation with a view to improvement, they are in fact looking to improve a system.

> *Everyone speaks of systems: computer systems, air traffic control systems, economic systems, and social systems. However, few realize how pervasive are systems, how imbedded in systems we are in everything we do, and how influential are systems in creating most of the puzzling difficulties that confront us. (Forrester, 1991)*

It is almost impossible to outline an area of concern with groups of people, without simultaneously outlining a system central to that concern Clemson (1996).

Although, system's thinking is natural to benefit, we need to understand and use the insights of the systems approach. The systems thinking approach makes conscious and formal use of the concept of wholeness, as captured in the word system. The concept of a 'system' embodies the idea of a set of elements dynamically related in time. Each of which can affect the performance of the whole (Beer, 2000) however, none of which can have an independent effect overall (Ackoff, 1994).

A system exhibits as a single whole, emergent properties which have no meaning in terms of the parts of the whole (Ashby, 1956).

> *'The system concept, the idea of a whole entity which under a range of conditions maintains its identity, provides a way of viewing and interpreting the universe as a hierarchy of such interconnected and interrelated wholes'. Checkland (1981)*

These definitions embody an approach that, unlike the reductionist methodologies, encourages an exploration of the relationships between elements, rather than concentrating on the properties of the individual elements themselves (Senge, 1990). Further, there is an implication that systems are governed by the dynamic interactions of their components. A system's conduct should be classified and analysed through the 'patterns of its behaviour', or its 'trends', not through seeking to predict events. This systemic perspective

encourages closed loop thinking, where we are looking for continuing interrelated processes, rather than one-way relationships (Ackoff, 1978).
The Systems Approach includes a set of theories that attempt to rigorously explore, analyse and diagnose systems behaviour, i.e. Viable Systems Model (Beer, 2000), Soft Systems Methodology (Checkland, 1981), Systems Dynamics (Senge and Sterman, 1992; Forrester, 1994), complexity and emergence (Nicolis and Prigogine, 1989).

The Systems Approach has proven its merits (Flood and Jackson, 1987). It is not the purpose of this paper to discuss them. What is important to reflect on in order to clarify our theoretical stance is, the observer has to be included as part of the system.
The most basic cognitive operation we perform as observers is the operation of distinction. It is through the operation of distinction that we specify a unity as an entity distinct from its background (Maturana & Varela, 1987).

We characterise both the unity and the background with the properties with which the distinction endows them and specify their separability. If the observer applies the operation of distinction recursively and, thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of systems. The autopoietic epistemological perspective suggests that cognition (the distinctions we make) is conditional to embodiment. The act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, not simply the act of processing what is objectively to be 'seen'. Thus, systems are epistemological qualities and not definitions of how things actually are or occur. Observers perceive or describe systems, and therefore, their boundary and their structure. Systems have become the means by which we explore and describe the consistency of situational behaviour; therefore, descriptions of system structures are useful tools. If some form of agreement can be reached about 'what a system does' then it is possible to communicate about its structure and boundaries with greater (in relative terms) coherence. Language needs to take account of a systemic vocabulary.

The definition of a system is a dynamical activity. It involves both objective and subjective reality and the cycle of perception and action, that unites them. Indeed, the definition of the system is likely to change in a whole host of ways when new distinctions are identified and become relevant. Thus, any attempt to freeze the definition of a system stifles creativity. It constrains knowing by forcing new explanations built on frozen categories, as though these were absolute truths given in nature rather than specified by us. Systemic language should continuously evolve and reinvent itself.

Since we exist in language, the domain of discourse that we generate becomes part of our domain of existence and part of the environment in which we conserve identity and adaptation. As observers, we live in a domain of recursive discourse. Thus, the unity of the human society is generated through the network of conversations that language generates and which through its closure generates language itself. Social systems exist, for their members, in co-creating reality.

It is through languaging that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together. Bohm (1987) suggests that a new type of dialogue is needed in human communications. The basic idea of this dialogue is to be able to talk while suspending our opinions, holding them in front of ourselves, neither suppressing nor insisting upon them, not trying to convince but simply to understand. We must perceive all the meanings of

everybody together, without having to make any decisions or saying who is right or who is wrong. It is more important that we all see the same thing.

In this way, an organisation is able to take conversations and collective practices to a deeper level. The form of dialogue, suggested by Bohm (2000), encourages opening up and engaging in listening without a particular purpose, listening for the sake of hearing what other thoughts and opinions there are, whilst trying consciously to suspend our assumptions and judgements. It is building awareness of what there is to be heard without focusing on it through the lenses of our judgements and assumptions. This 'listening' increases our chances of becoming sensitive and thus, able to hear the prejudices of agents outside ourselves.
This form of dialogue should be seen as a core element within any human enterprise, as it creates the context for all activities, rather than (as may be suggested by more traditional communication approaches) being merely part of the chain of activities. Dialogue is about involvement, about co-creation and communication. Therefore, a generative dialogue process in organisations will enhance their capability of developing a meaningful language providing a valid venue for second order understanding.

A 'Second Order' Organisational Improvement

The process, outlined in Figure 2, has been developed as an interpretation of the application of 'second order understanding', systems thinking and autopoiesis to organisational improvement. It is a closed cycle of exploring, reflecting, and developing language in dialogue. It is not action research conducted by a third party, but enactive research conducted by members of the organisation, with input and assistance if required from a third party. The process includes seven stages that are not necessarily conducted sequentially. The process has also been designed with the intention of emerging a solution based on understanding of the situation and its interpretation by others. We do not clam that this is the first or only second order approach only that it can be applied generically by the people actually involved in the situation without the need for academics or consultants leading the investigation. However this does not exclude academic or consultative involvement. The point being it is the people involved in the situation that decide the amount of external involvement required.

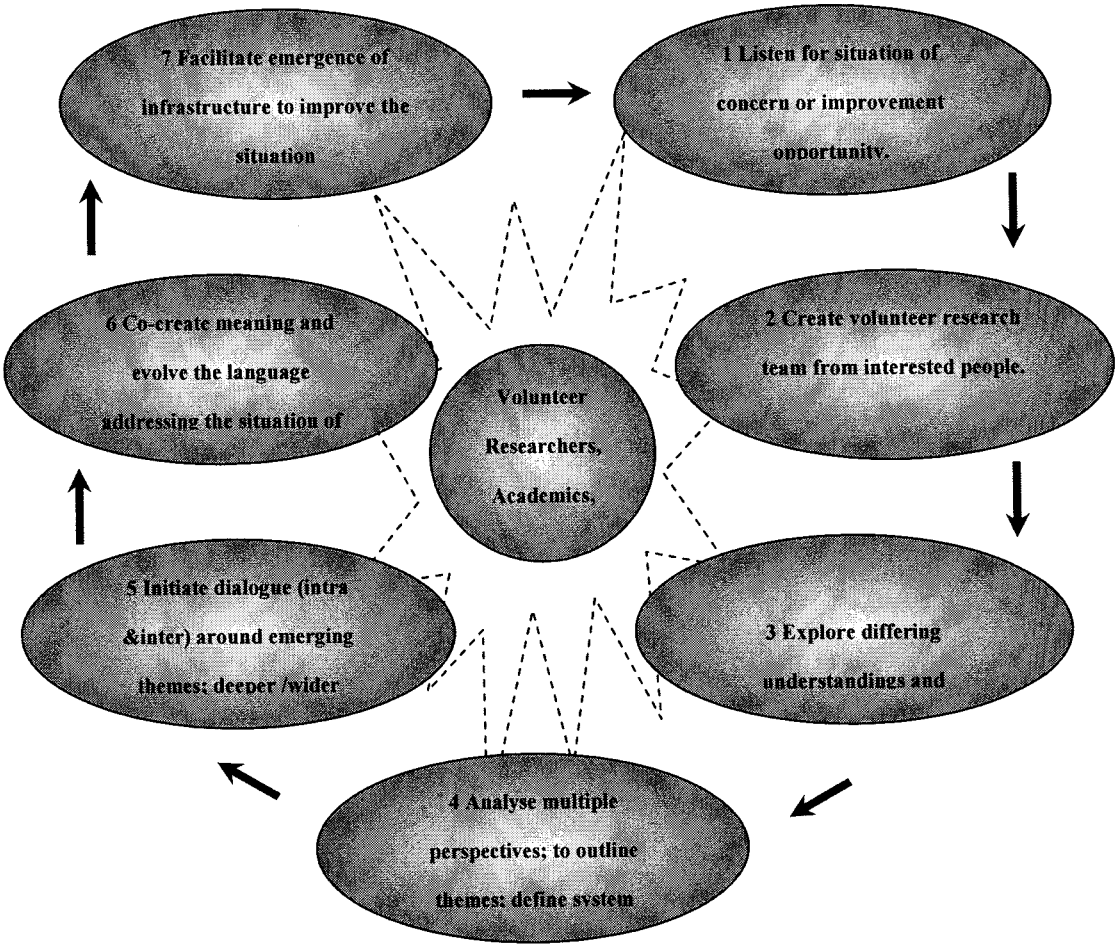

Figure 2. The Second Order Organisational Improvement Process

The seven stages of the process are outlined in brief below, unfortunately to give detailed examples would require an additional paper. However some small examples are given within the stage descriptions

Stage 1: Listen For Situations of Concern or Opportunities to Improve.

Stage 1 is a stage of observation and exploration. While carrying out daily activities the researcher (who we have said is an employee of the organisation) is constantly exploring situations of concern related to process performance, quality produced or any other organisational phenomenon. The researcher is also open to improvement opportunities within the organisation. Such opportunities could come in the form of changes to requirements or specifications, new methods or materials becoming available, ideas and suggestions from other members of staff and new attitudes developing within the organisation, its suppliers or customers.
Opportunities for improvement can come from all directions, internally or externally. Therefore, all members of an organisation can act as sources or conduits for improvement initiatives.
In one instance a change to employment law required the establishment of a time and attendance system within Draeger Safety UK. Such a system had not been utilized within the organisation and could if handled incorrectly have been seen as a mark of distrust by management. This situation proved an ideal use of 'second order understanding' approach rather than just imposing by dictate what would be seen as an enforced clocking in system on the workforce.

Stage 2: Create Volunteer Research Team.

Once such awareness of a concern or opportunity for improvement has developed, Stage 2 brings together a group of individuals who have an interest in the situation.
While the improvement team will primarily consist of organisational members, there is no reason why expertise from external sources such as academics and/or consultants cannot be utilised if appropriate to the situation. However, all members of the team will bring some form of expertise from their own knowledge and experience. Therefore, academic expertise is no more important or more valid than the expertise of any other member. External academics can fill knowledge gaps or provide links to external knowledge sources, etc. They are not expected to lead the team or steer the direction of research; this will stifle the very nature of second order improvement by restricting the exploration of differing understandings.

Whatever their internal or external makeup, teams consisting of volunteers have proved more productive than teams consisting of members directed to take part. It appears the old adage "one volunteer is better than ten pressed men" is true in this case. Therefore, volunteer teams are the preferred option. If team members are directed to partake, to give for example a selected departmental representation, then people involved with the situation in their daily activities, are preferred.

For the time and attendance system the human resources department issued a communication via weekly briefing sessions and email for interested individuals to volunteer to become involved in the development and introduction a system that would satisfy the new statutory requirements. A selection of individuals was then made representing the workforce in general and invited to form a team, nominating their own agenda team leader etc,. to fulfil the required time and attendance verification criteria.. Although, the intention is to emerge a volunteer team, the formation of improvement teams will always be influenced by organisation practice and may require a compromise. However, this does not preclude as was the above case using only volunteers within an invited team.

Stage 3: Explore Differing Understandings and Worldviews.

The team undertakes an examination of their varying views of reality, neither accepting nor rejecting others' worldviews. The intention is to look without judgment, accepting that others' views will differ but constitute valid reality for each individual.
The result of stage 3 is the clarification and understanding of others understanding with regard to the situation of concern.

The criticality of conducting this stage in the form of a dialogue cannot be stressed too strongly. Dialogue is used in coming to an understanding of the situation, ones own and others' attitudes, prejudices and preferences with regard to improvement. If an individual or sub group hijacks stage 3 or any stage for that matter, using debate or direction to overrule others' opinions from a position of hierarchy, then second order understanding fails. People refrain from sharing their true beliefs going along with the senior person present. Not believing but complying with his or her version of reality. 'Second order understanding' can only come from mutual respect for other peoples opinions and worldviews. We do not have to agree, only allow others to speak while we listen to what is actually being said.

Stage 4: Analyse perspectives, Outline Themes and Define System Boundaries.

Stage 4 analyses the differing perspectives, searching for recurring themes and contradictions. It aims at defining the system, its purpose and establishing its boundaries.

The positioning of system boundaries is critical. Boundary construction defines the visualisation of issues and scope of subsequent enaction. If examined, we can class them as first and second order system boundaries. The first order boundary looks at facts and data, ignoring people. Second order boundaries include people and their perceptions. As people have differing worldviews, it is possible for each to place the system boundary in differing positions. People will place boundaries in accordance with their view of the system and it purpose. Therefore, the boundary set by an individual from the marketing differ from that drawn by someone from production or research and development; IT may have another boundary, accounts another, and so on. Boundaries will also differ even within the same department or section. It is tempting to redraw the boundary to encompass all of the boundary variations as a simple way of obtaining agreement. However, this is not the best of ideas, as it increases the complexity of the system. As the boundary extends outwards complexity increases. Churchman (1970, 1979) maintains that the boundary must be set to sweep in as much understanding as possible, thus creating a rich and complex picture, without compromising the meaning of the analysis. However, Ulrich (1983) points out that the purpose of the analysis will impose limits to the possible placement of the boundary.

In the time and attendance case, boundary definition was relatively simple. The fist order boundary contained the hardware and software used to run the system. With factual questions such as, will the system perform the tasks required by the new working time directive legislation? Is the system of time registration user friendly and quick? Can the system be updated and expanded as the need arises etc being asked. As for second order boundaries, every individual on site from the Managing Director down would be affected therefore the second order boundary encompassed the entire workforce.

Stage 5: Initiate Dialogue (Intra & Inter) Develop Understanding of Assumptions.

Up to this point, dialogue and understanding has been confined to the members of the improvement team, this we term Intra dialogue. It cannot be assumed, in fact unlikely, that a team will have all the requisite variety or be in a position to answer all of the questions that could arise. Stage 5 moves from the intra dialogue of the team into the wider world of the situation of concern.

To develop wider understanding the team must communicate the results of previous stages to the people affected. Stage 5 develops a feedback loop between the team and people within or affected by the situation of concern. Communication initiated by the team creates feedback that can change perspectives, causing rethinking of the team understandings. Thus, stage five iterates between the 'intra' (within the team) and 'inter' (wider) dialogue.

When only a small number of people are affected, this stage is comparatively simple. However, some cases involve large numbers of people in exploring the situation of concern. For example, at Draeger Safety UK, the introduction of a new time and attendance system affected the entire workforce. In that instance, open questionnaires, distributed with individual's salary slips, ensured every staff member received an opportunity to partake. Once returned the issues and questions raised were posed to the departments and individuals that could provide the answers. When collated into question

and answer sheets, several organisational methods were available to provide feedback. In this case, weekly briefs attended by all staff members provided the communication channel for feedback and an iterative communications loop between the improvement team and the workforce.

Stage 6: Co-create Meaning and Language to Address the Situation.

Habermas (1948a, 1948b, 1976) discussing language and speech acts, points out that a shared language makes communication possible, that people then pass information and reveal their inner thoughts, while establishing interpersonal relationships. From an autopoietic standpoint, Maturana and Varela (1987) maintain that observers operate in linguistic domains, which become part of the environment, creating shared meaning. Therefore, stage 6 is about co-creating meaning through language, agreeing on a language understood by all. The outcome is the development of a shared language to deal with the situation. This language is systemic, and is never complete, but develops as new understandings emerge.

Stage 7: Facilitate Emergence of an Infrastructure to Improve the Situation.

For organisational improvement, we must use the developed understanding to enact change. Stage 7 facilitates the development of the infrastructure for change.

In developing the infrastructure for change, it is important to consider the vertical and horizontal dimension of implementation teams. Organisations have vertical (hierarchical) and horizontal (interdepartmental) dimensions. In the enactment of change, both dimensions are important to success. One approach to developing implementation infrastructure is shown in Table 1.

Department A	**Department B**	**Department C**	**Department D**
Departmental Head	Departmental Head	Departmental Head	Departmental Head
Supervisor	Supervisor	Supervisor	Supervisor
Specialist	Specialist	Specialist	Specialist
Action Implementers	Action Implementers	Action Implementers	Action Implementers

Table 7. Departmental and Interdepartmental Infrastructure

Vertically each team has members from all levels of the department, championed by the departmental manager. The horizontal teams consist of one member (at similar organisational level) for each department. The horizontal element brings the interdepartmental communication and exchange of ideas and opinions. Professor David Weir referred to this approach as 'deep slice' during a workshop conducted at Draeger Safety UK in 2004.

The process outlined in Figure 2 is iterative. It is a closed cycle of exploring, reflecting and developing language in dialogue. It is a second order process of improvement, where the process of enquiry involves understanding, not only of one's own perceptions of a situation ('first order understanding'), but also, understanding of others' worldviews, i.e. 'second order understanding', analogous to Heinz von Foerster's (1979) second order cybernetics. In the proposed process, people participate as researchers in their own right. It is not action research conducted by a third party, but research conducted by employees with input from a third party. The process of enquiry described introduces a systemic second order approach to research. Embedded in the practices is dialogue, exploring multiple perspectives, developing language, etc. However, it is important to understand

that this is not a prescription. Practices can take different forms and focus depending on the particular context and organisational circumstances. In real life, these overlap and do not necessarily follow in sequence.
For our example once hardware and software become available, trial system runs with differing departments and mixes if functions took place to capture anomalies and work through bugs before introduction of the system to the entire workforce.
As a result the system went into use with few problems and those that did surface were easily rectified.

Towards a Conclusion

We have argued in this paper that there is a need for a second order process of organisational improvement. We have developed and tested a generic model of such a process and reflected on its implementation.

The second order process does have drawbacks. Trials have proved that improvement team formation is critical to success. Firstly, the process relies upon building trust within the team. Trust enables true dialogue and exchange of ideas to take place. If trust is not present then the process will fail, people will be reluctant to speak freely thus, understanding of others' views cannot develop.

The second order model allows change to emerge from understanding. The people taking part choose the tools and methods to uses that best suit the individuals and situation.

The second order model has limitations as it can only be effective within an open culture where trust and honesty are present. However, this limitation is shared with all other methods such as Soft Systems Methodology (Checkland, 1999) that rely on people giving their view of the world as they actually see it, not as they think the organisation wants or expects them to see it.

The Second Order Process of Organisational Improvement has been tested and successfully implemented at Draeger Safety, UK. It generated improvements that could never have been attained by using the traditional Problem Solving Process.

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A Second-order Process for Organisational Improvement

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Abstract
This paper looks at the process of organisational improvement in quality frameworks. It explores the potential of applying systems thinking and organisational learning to evaluating and amending this process. It takes a holistic approach that views organisations as human communities and puts people in the centre of any quality improvement endeavour. It argues that understanding of other people's understanding (second order understanding) of the world will lead to meaningful communication in organisations. A generic model of a process of improvement taking into account second order understanding principles is developed. A case study is used to reflect on the implementation of such a process in practice.

Keywords: autopoiesis, social systems, language, dialogue, systems thinking, second order understanding

Introduction

Quality and quality frameworks are commonplace within today's business environment. However, these frameworks do not guarantee quality. This paper looks at the process of organisational improvement in quality frameworks. It explores the potential of applying systems thinking and organisational learning to evaluating and amending this process. It takes a holistic approach that views organisations as human communities and puts people in the centre of any quality improvement endeavour. It argues that understanding of other people's understanding (second order understanding) will lead to meaningful communication in organisations.

Organisational Improvement and the Problem Solving Process in Quality Frameworks

Today most organisations use a quality framework, with the view that quality is the responsibility of the entire organisation, that culture, knowledge, learning and understanding all play a role in the final quality produced . The main improvement tool of such frameworks is the Problem Solving Process (PSP). The name gives rise to the assumption, that the organisation must have a problem that has been identified before the process can be used.

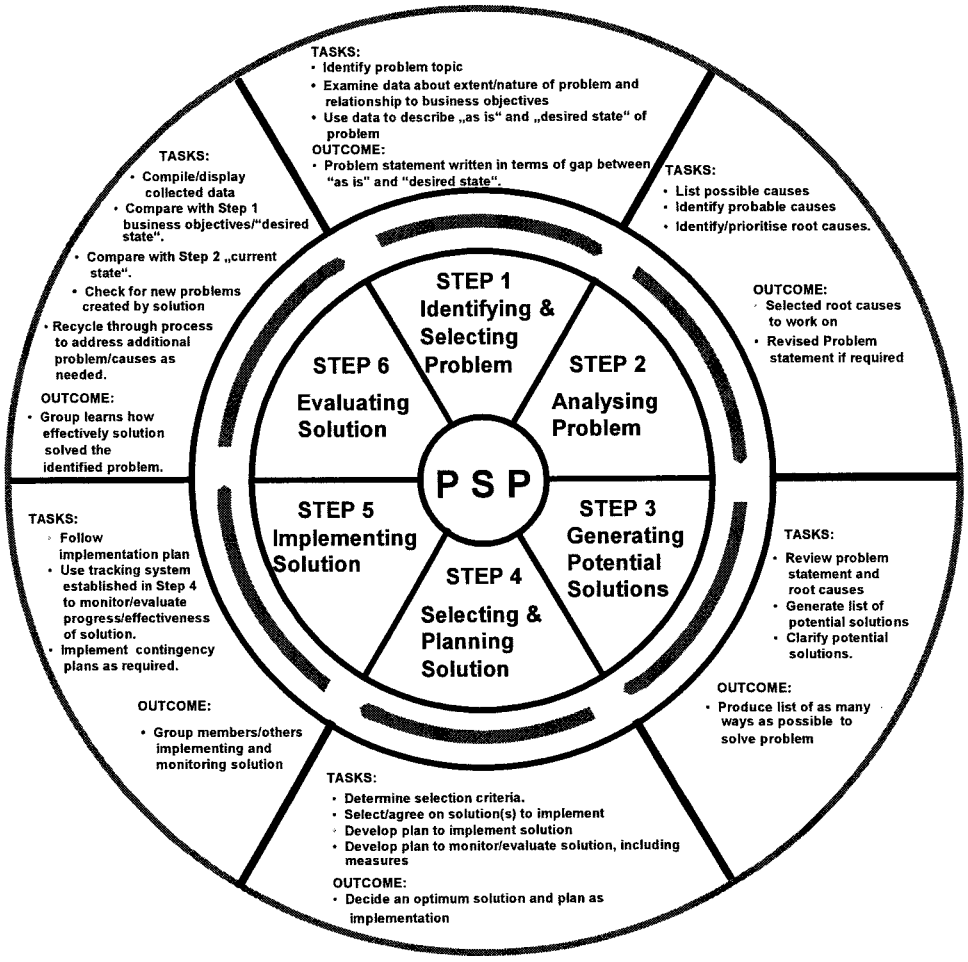

Figure 1. Problem Solving Process (as part of the quality framework at Draeger Safety, UK)

Additionally the PSP is a closely ordered systematic procedure (Figure 1). The six steps are carried out in sequential order, with outputs from one becoming inputs to the next. This is clearly an 'objective' enquiry, examining only objective facts, where synergy of multiple worldviews and the opportunity of co-evolving reality through engaging in understanding others' understanding of reality, i.e. second order understanding, do not enter into consideration. This reductionist, subject/object dualistic approach is typical of the manufacturing sector. For example, one of the first steps of the PSP is to define the root cause of the problem. No contemplation of the possibility that the problem may have many levels or contributing factors acting in unison is considered. A common problem with the root cause philosophy is that it is linear and hard to account for feedback and iteration. The PSP has drawbacks that a second order understanding approach, can overcome.

Theoretical Perspectives Informing the Search for a Second Order Process of Organisational Improvement

A holistic approach, that views organisations as human communities, puts people in the centre of any quality improvement endeavour. In order, to make sense, of people centred quality improvement, it is important to clarify our assumption about the human condition. The theoretical perspectives, informing the inquiry into the human condition in this article, include theory of autopoiesis (Maturana and Varela, 1980) and systems thinking.

Autopoiesis, Experience and Knowledge

It is through our particular way of being that we act as observers. Thus, everything we say (even to ourselves), is said by one observer to another. Consequently, our capacity to distinguish and therefore, our knowledge, depend upon the make-up of the particular observer.
Since the observer is a living entity, a 'true' insight into the domain of knowledge requires an understanding of cognition that takes into consideration the biological phenomenon and is also mindful of the observer's role within it. The theory of autopoiesis is based on explaining the generative process of the living.
Autopoiesis is the mechanism that defines the manner in which a living system exists as a distinguishable entity.
An Autopoietic system is a network of processes for production of components that:

(i) Through their interaction and transformations continuously, regenerate the network of processes that produced them.
(ii) Constitute the entity as a concrete unity in the space by specifying the topological domain of its realisation as such a network.

Consequently, an autopoietic system that exists in a physical space can in general be thought of as a living system.
Autopoiesis is basic to the living individual. What happens to the individual is subservient to its autopoietic organisation, for as long as it exists the autopoietic organisation remains invariant. What this means, is that the living individual is an autonomous entity that actively maintains its identity. Its identity and therefore its emergent global properties are generated through a process of self-organisation within its network of components. A two-way process of local-to-global and global-to-local causation (Figure 1) conditions this process of self-organisation.

Figure 1 The Mutual Embeddedness of Component Dynamics, Autopoietic Entity and its Environment.

Firstly, there is the local-to-global determination ('upward' causation) through which the entity, with its properties, emerges. Secondly, however, there is global-to-local determination ('downward' causation), where global characteristics constrain or direct local interactions between the components (Varela, 1979). For example, in organisms with a nervous system, the rules of interactions within the neuronal network are in reciprocal relationship with the overall activity of the autopoietic entity. Largely, behaviour is a regulator of perception. That is to say, what the organism senses is a function of how it behaves, and how it behaves is a function of what it senses. Situated behaviour, thus, takes the form of coupling (often referred to as 'structural coupling') with the environment, where environmental perturbations trigger changes in the entity but do not determine them, because changes in autopoietic systems are necessarily subservient to conservation of identity.
The dialectics of the living are based on the necessary emergence of a meaning relevant to the perspective of the cognitive self (for example one's perception), and on a coupling with the environment which refers to the necessary dependence of the self on its environment (for example socio-linguistic interactions). Consequently, the contents of human experience (how the world appears to us); depend crucially on the mutual embeddedness of the neuronal dynamics (included in the overall physical and chemical dynamics), the human agent as a unity with global properties (body, mind, consciousness, self and so on)

and, the environment. Thus, human experience is personal but not private. Experience is clearly a personal event, but that does not mean it is private, in the sense of some kind of isolated subject that is parachuted down onto a pre given objective world. This irreducibility of human experience, from the duality portrayed by the embodiment and the situatedness of the human agent, cannot be underestimated when developing approaches or methodologies for research.

Autopoiesis and the Role of Language

The coupling of a living organism with its environment may include interacting with other organisms and if the interacting organisms reciprocally select each other, their respective paths of ontogenic structure changes, generating a domain of communicative interactions. The individual ontogenies of the participating organisms occur as part of the network of co-ontogenies that comes about in constituting higher order or social unites.

> *'As observers we designate as communicative those behaviours which occur in social coupling and as communication that behavioural co-ordination which we observe as a result of it'.*
> (Maturana and Varela, 1987)

This consensual domain of communicative interactions in which behaviourally coupled organisms orient each other with modes of behaviour, whose internal determination has become specified during their coupled ontogenies, is a linguistic domain. The name 'linguistic domain' was chosen because such learned communicative behaviours constitute the basis for language, although they are not identical with it. The conduct of each organism is internally determined by its autopoietic structure; however, the conduct of one organism is a source of perturbations for the others while the coupling lasts. The linguistic domain, therefore, is intrinsically non-informative, although the observer may describe it as if it were so. What determines the interaction is the dynamics of structural coupling of the interacting organisms.
Such a view contradicts the more traditionally established metaphor of 'the transmission of information', in which, communication represents something generated at a certain point, carried through an information channel and delivered to a receiver. This metaphor is not correct, since biologically there is no transmitted information. Moreover, it presupposes that what happens to the receiver (listener) is predetermined only by the perturbing agent (sender). In fact, however, communication depends on not only what is transmitted, but also what happens in the organism that receives it. Communication, therefore, is a matter of mutual orientation, primarily with respect to each other's behaviour, and secondarily with respect to some subject (Maturana and Varela, 1980).
Therefore, language is a venue for action, coupling the cognitive domains of two or more actors. Language should not be regarded as a system of symbols that are composed into patterns that stand for things in the world and thus reveal our 'objective' knowledge of it. Words are tokens for linguistic co-ordination of actions and not things we move from one place to another. Thus, it is appropriate to discuss languaging as an act rather than language as a symbolic notation. Since we exist in language, the domain of discourse that we generate becomes part of our domain of existence and part of the environment in which we conserve identity and adaptation. As observers, we live in a domain of recursive discourse. Thus, the unity of the human society is generated through the network of conversations that language generates and which through its closure generates language itself. Social systems exist, for their members, in co-creating reality. Where language agreements decide what is true and what is false. Thus, meaning becomes fundamentally social and language becomes part of everyday being in the world. Therefore, we agree that:

' Human agreements decide what is true and what is false? It is what human beings say that is true and false; and they agree in the language they use. That is not agreement in opinions but in form of life'.
(Wittgenstein, 1967)

The world is continuously innovated generating new possibilities through communication. Thus, by its design the communication structure needs to be open to evolution in order that it can accommodate and promote new opportunities. Autopoietic theory reintegrates the individuals as the fundamental creators of the communication structure.
It is through languaging that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together. Bohm (1987) suggests that a new type of dialogue is needed in human communications. The basic idea of this dialogue is to be able to talk while suspending your opinions, holding them in front of you, neither suppressing nor insisting upon them, not trying to convince but simply to understand. We must perceive all the meaning of everybody together, without having to make any decisions or saying who is right or who is wrong. It is more important that we all see the same thing.
In this way, an organisation is able to take conversations and collective practices to a deeper level. The form of dialogue, suggested by Bohm (2000), encourages opening up and engaging in listening without a particular purpose, listening for the sake of hearing what other thoughts and opinions there are, what is being said, whilst trying consciously to suspend our assumptions and judgements. It is building awareness of what there is to be heard without focusing on it through the lenses of our judgements and assumptions. This 'listening' increases our chances of becoming sensitive and thus, able to hear the prejudices of agents outside ourselves.
This form of dialogue should be seen as a core element within any human enterprise, as it creates the context for all activities, rather than (as may be suggested by more traditional communication approaches) being merely part of the chain of activities. Dialogue is about involvement, about co-creation and communication. Therefore, a generative dialogue process in organisations will enhance their capability of developing a meaningful language providing a valid venue for action and continuous learning.

The Systems Approach, Autopoietic Epistemology and Language

Insights from the systems thinking tradition are considered helpful in providing a holistic perspective. The systems thinking approach makes conscious and formal use of the concept of wholeness, as captured in the word system. The concept of a 'system' embodies the idea of a set of elements dynamically related in time. Each of which can affect the performance of the whole (Beer, 1979) however, none of which can have an independent effect overall (Ackoff, 1994). The system exhibits as a single whole emergent properties which have no meaning in terms of the parts of the whole (Ashby, 1956).

'The system concept, the idea of a whole entity which under a range of conditions maintains its identity, provides a way of viewing and interpreting the universe as a hierarchy of such interconnected and interrelated wholes'.
(Checkland, 1981)

These definitions embody an approach that, unlike the reductionist methodologies, encourages an exploration of the relationships between elements, rather than concentrating on the properties of the individual elements themselves, therefore considering performance in terms of the systems structure (Senge, 1990). Further, there is an implication that

systems are governed by the dynamic interactions of their components, a system's conduct is classified and analysed through the 'patterns of its behaviour', or its 'trends', rather than through seeking to predict events. This systemic perspective encourages 'closed loop thinking', where we are looking for continuing interrelated processes, rather than one way relationships (Ackoff, 1978).

The Systems Approach includes a set of theories that attempt to rigorously explore, analyse and diagnose systems behaviour, i.e. Viable Systems Model (Beer, 1979), Soft Systems Methodology (Checkland, 1981), Systems Dynamics (Senge and Sterman, 1992; Forrester, 1994), complexity and emergence (Nicolis and Prigogine, 1989).

The Systems Approach has proven its merits (Flood and Jackson, 1987). It is not the purpose of this paper to discuss them. What is important to reflect on in order to clarify our theoretical stance is, the observer has to be included as part of the system.

The most basic cognitive operation we perform as observers is the operation of distinction. It is through the operation of distinction that we specify a unity as an entity distinct from its background (Maturana and Varela, 1987). We characterise both the unity and the background with the properties with which the distinction endows them and specify their separability. If the observer applies the operation of distinction recursively and, thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of systems. The autopoietic epistemological perspective suggests that cognition (the distinctions we make) is conditional to embodiment. The act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, and not simply the act of processing what is objectively to be 'seen'. Thus, systems are epistemological qualities and not definitions of how things actually are or occur. Different observers perceive or describe systems, and therefore, their boundary and their structure differently. The observer has to be accounted for as part of any explanation. Nevertheless, systems have become the means by which we explore and describe the consistency of situational behaviour. Therefore, descriptions of system structures are useful tools and, if some form of agreement can be reached about 'what a system does' then it is possible to communicate about its structure and boundaries with greater (in relative terms) coherence. Language needs to take account of a systemic vocabulary.

The definition of a system is a dynamical activity. It involves both objective and subjective reality and the cycle of perception and action, that unites them. Indeed, the definition of the system is likely to change in a whole host of ways when new distinctions are identified and become relevant. Thus, any attempt to freeze the definition of any system stifles creativity. It constrains knowing by forcing new explanations to be built on frozen categories, as though these were absolute truths given in nature rather than specified by us. Systemic language should continuously evolve and reinvent itself.

A Second Order Process of Organisational Improvement

The process outlined in Figure 2 has been developed as an interpretation of the application of autopoiesis and second order systems thinking to organisational improvement. It is a closed cycle of exploring, reflecting and developing language in dialogue. It is a second order process of quality improvement, by which the process of enquiry involves understanding, not only of one's own perceptions of a situation (first order understanding), but also, understanding of others' worldviews, (second order understanding, analogous to Heinz von Foerster's second order cybernetics). In the process, people participate as researchers in their own right. It is not action research conducted by a third party, but research conducted by employees with input from a third party. The process includes seven stages that may or may not be followed in sequence.

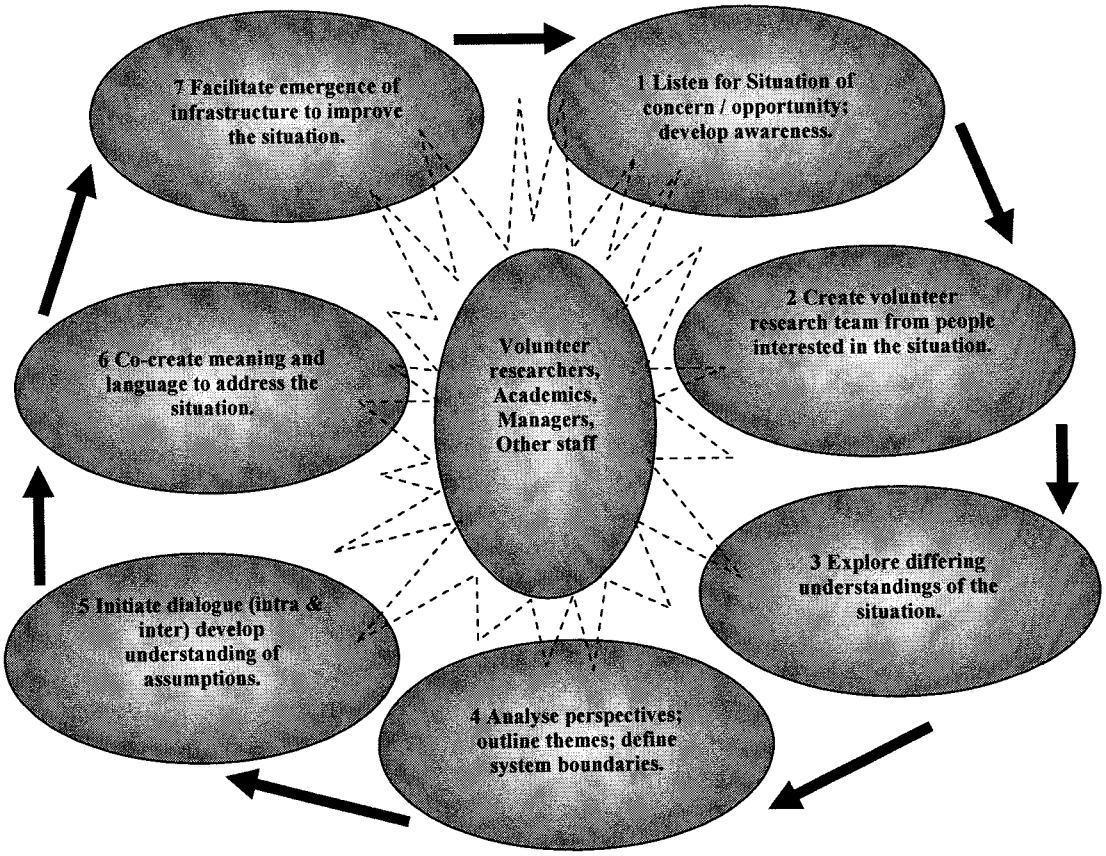

Figure 2. The Second Order Organisational Improvement Process

The Seven Stages of the Process

Stage 1

Stage 1 is a stage of observation and exploration. While carrying out daily activities the researcher, (whom we have said is an employee of the organisation) is constantly exploring situations of concern related to process performance, quality produced or any other phenomenon that is detrimental to the organisation. The researcher is also open to opportunities to improve processes that have no discernable concern. Such opportunities could come in the form of changes to requirements or specifications, new methods or materials becoming available, ideas and suggestions from other members of staff and new attitudes developing within management and staff of the organisation.

Stage 2

Once such awareness has developed, Stage 2 brings together a group of around five to seven individuals who have an interest in the situation. Research using the process has indicated that this stage can have profound effects on the outcome. The group should be of similar hierarchical standing and have as its initial objective the understanding of the situation through the lenses of other team members as well as their own; this will begin the process of understanding others' understanding.

Stage 3

Stage 3 begins the exploration of differing understandings. People base their thinking and therefore conclusions and subsequent actions on preconceived beliefs. The team undertakes an examination of their varying views of reality, neither accepting nor rejecting them. Looking without judgment, accepting the views of others' exist and for them constitute reality. In this way, the varying realities of the team members are explored and surfaced.

Stage 4

Having surfaced the varying views of reality Stage 4 analyses the differing perspectives, searching for recurring themes and contradictions. Defining the system affected, establishing boundaries and focusing onto the areas and people of importance to the investigation. The positioning of system boundaries is critical. Boundary construction defines the visualisation of issues and subsequent actions. If examined, we can class them as first and second order system boundaries . The first order boundary looks out from inside the system towards the world, seeing only the data, ignoring people. Second order looks into the system from the outside. Second order boundaries influence the view of reality, with the inclusion of people and their perceptions. As the boundary extends outwards complexity increases. Churchman maintains that the boundary must be set to sweep in as much understanding as possible, thus creating a rich and complex picture without compromising the meaning of the analysis. However, Ulrich points out that the purpose of the analysis will impose limits to the possible placement of the boundary.

Stage 5

Stage 5 brings dialogue fully into play, this stage deepens and increases shared understanding. The aim is to arrive at a view of reality shared by the team that incorporates, while clarifying varying realties. The dialogue around themes has vertical and horizontal dimensions. Within the team (intra) is vertical, while (inter) is the horizontal dimension moving out from the team into the systems and people affected. This will provide a holistic view of the system, deepening overall understanding, while at the same time extending that understanding externally from the team to the people affected. Use of the horizontal 'inter' dimension, causes shared understanding to undergo change, as new views of reality are exposed and new knowledge uncovered.

Stage 6

On reaching stage 6, the team can commence co-creation of the language and meaning to address the understandings gained from other stages. As human beings, we communicate and conduct our lives through language. Organisationally we use many languages, the language of the boardroom, the workshop, technical languages, etc. Most are full of terminology unknown to people outside the particular discipline. For the development of meaning, a common language understood by all is required. Habermas discussing language and speech acts, points out that a shared language makes communication possible, that people then pass information and reveal their inner thoughts, while establishing interpersonal relationships. From an autopoietic standpoint, Maturana and Varela maintain that observers operate in linguistic domains, which become part of the environment, creating shared meaning. Therefore, stage 6 is developing meaning through language, defining a terminology understood by all. The outcome is the development of a shared language to deal with the system. Language supports and offers a window into understanding of others' understanding, directing our perceptions and altering our beliefs.

Stage 7

Stage 7 facilitates the development of the infrastructure of change. An infrastructure that will transform newly emerged meaning, language and understanding into action. Action that develops the understanding into organisational quality improvement, conducted not by external consultants but by the members of the organisation. One such method of infrastructure development is a cross-functional interdepartmental action group as shown in Table 1:

Table 8. A Cross functional Interdepartmental Action Group

Department A	**Department B**	**Department C**	**Department D**
Departmental Head	Departmental Head	Departmental Head	Departmental Head
Supervisor	Supervisor	Supervisor	Supervisor
Specialist	Specialist	Specialist	Specialist
Action	Action	Action	Action
Implementers	Implementers	Implementers	Implementers

As can be seen from Table 2, groups have a vertical departmental based element. Vertically each group has members from all levels of the department, championed by the departmental manager. The horizontal teams consist of one member (at similar organisational level) for each department. The horizontal element brings the cross-departmental communication and exchange of ideas and opinions. Whatever implemented action takes place, stage 7 is about changing situations and mindsets that result in sustained organisational quality improvement. Professor David Weir referred to this approach as 'deep slice' during a workshop conducted at Draeger Safety UK in 2004.

The Process in Use: A Case Study

The process has undergone several practical applications during development. The introduction of a time and attendance system outlined below provides a case study. The time and attendance project had two elements, technical and social. Technically software and hardware was required, while the social element concerned the reactions of people. What view would people take, a reduction in trust and big brother watching? That was certainly one way to view the system.

The technical element of the project was simple in comparison to the social; IT was available from many sources, several systems being able to provide all the functionality of the time and attendance criteria. In short, the team only had to draw up a system specification and do some simple arithmetic to cover the requirements of the systems technical element. Therefore this study will concentrate on the more interesting and problematic side of the social implications of systems introduction. It must be realised that prior to the introduction of the system no time and attendance system existed. Time and attendance ran on trust and mutual agreement between management and staff. Trust that gave a degree of flexibility in start and finish times that benefited both management and staff.

In Stage 1 awareness of a need to introduce a time and attendance system grew within senior management. Changes to the European working time directive (2005) required, verifiable documentary evidence as proof of hours worked by individuals. The system or should we say lack of a system, provided no documentation whatsoever covering the actual hours worked by an individual at Draeger Safety UK, this situation clearly required addressing in order to comply with the directive. Management decided to use the second order process; this allowed recognition of peoples' involvement within the system. A

small volunteer team of six people formed to oversee the introduction. The team contained members of similar hierarchical standing, most having worked together in the past.

Thus, stage 2: team creation, entailed a request for volunteers and a selection of individuals that would provide cross-departmental input. Human Resources would eventually take responsibility for the system and therefore, selected and lead the team.

Stage 3 saw the exploration of differing understanding for the need, and use of a system. The team, over several informal meetings discussed the varying views and assumptions held by members. As an aid to the development of dialogue and an exchange of ideas the team agreed to dispense with detailed agendas for meetings, choosing instead meeting themes. The use of themes allowed a richness to emerge, with members discussing in greater depth general ideas rather than specific closely controlled topics. Several understandings of possible differing viewpoint emerged:

- A system required to answer the working time directive;
- A system to allow management to track peoples' time and attendance, collecting evidence that could be used in disciplinary procedures;
- A way of providing reports about building occupancy in case of fire;
- A sign that management simply, did not trust staff;
- A system that provided the possibility of flexitime working.

The above were the main viewpoint surfaced in stage 3.

Stage 4 saw the analysis of the understandings and definition of system boundaries. The boundaries of the system took little identification. Physically the first order boundary covered the entire site, while the second order social boundary enclosed every member of Draeger Safety UK staff. The working time directive required the introduction of a system. From a management view, this could be a costly unwanted system or an ideal opportunity to introduce a contentious system, while blaming the European Union. We will never actually know the view held however; it was the view of the staff that would spell success or failure of the system. Staff reaction to system introduction could move in a detrimental direction. If this became the case, then trust would diminish, resulting in a reduction of harmonious cooperation. One view put forward by management was of an occupancy report system, for use in building evacuation. The Safety officer, who pointed out that, the Draeger Safety UK site consists of six separate buildings, dispelled this view. It took only one person to enter or leave any of the six building without registering at a terminal to invalidate as unreliable any building occupancy report. This reason alone precluded this as a realistic use of the system. That the system was to answer the need to comply with the working time directive was evident and became the primary shared understanding. However, the possibility that people could view the system as big brother watching also existed. The team came to the understanding that the message to the workforce must be that, the system, while not particularly welcomed was necessary and it was up to the workforce via the team to determine how it was to function. The message sent out in stage 4 was simply. "Due to the working time directive the time and attendance system is coming, like it or not, it is up to us the workforce, to ensure that the system functions the way we want it to".

Stages 4 and 5 then ran in tandem. Broadcasting the message at every opportunity became the focus. The message went out through weekly briefs, communication sessions, and statements at shift start meetings and informal conversations in the canteen and smoking room. The team used every communication method available to get the message to the workforce. As a means of creating feedback, the team distributed a questionnaire, asking

both specific and open-ended questions. Each member of the workforce had the opportunity to complete and return a questionnaire. Once returned analysis of the replies produced a list of frequently asked questions' the team could answerer some, others required referral to senior management. Once all questions had answers, the team again took every opportunity to distribute both the list of questions and the answers.

Stage 6 entails co-creating meaning and developing a language for the system. Language and meaning development entailed defining what was meant by a proximity card, a login unit an entry sensor, what is the actual definition of a time and attendance system and how will the information be used? The team discussed all this and more, incorporating there understanding into the time and attendance system vocabulary. Procedures to cover not only daily use but also exception had to be developed. Procedures for lost cards, off site visits, forgotten cards all required communication to the workfare to give them the chance to comment. This also allowed the team to revisit previous steps, reconsidering the situation in light of new understanding gained from process discussions and staff feedback, before the system went live.

Stage 7 saw the return of the IT element. Software was installed login units positioned and a trial run of the system commenced. Following the successful trial of the system, it went live in January 2005. The successful going live of the time and attendance system proved the success of the second order process in this instance. The system went live with no animosity or feeling of system distrust from the workforce. The general view held being, "introduction of the time and attendance system truly was to comply with the working time directive".

If we consider the time and attendance project from a first order PSP (Figure 2) approach we immediately lose the emphasis on understanding others' understanding, thus our social perspective becomes ignored. The PSP six steps cover many aspects but has no mention of the people affected by the implementation of the derived solution. PSP step 1 entails a gap analysis in this case the existing situation being 'no documentation', while the desired state is 'to have documentation'. This gives us a gap of 'we need to produce documentation'.

Steps 2 – 6 require problem analysis, planning and implementing a solution and evaluating the implementation. What the PSP does not do in any stage is to ask the question, how will the people affected view this change or what effect will this change, have on moral and thus performance? For the PSP the process is simply the IT aspect, 'find a suitable IT system, install it and tell people they will be using it from a given date'. This is a recipe for disaster; animosity and ill feeling are the inevitable outcomes of this approach.

In contrast, the second order process specifically focuses on the understanding of others'. Putting understanding of the situation and people involved first ensures that social aspect and understanding take centre stage. The case study chosen is an example of a project that requires second order thinking, the problems will arise not from the technical aspects but from the social reactions of the people affected by the change. The process, if used as in the case study lends itself to situations that require the co-operation of the people affected, the first order PSP is inadequate in these types of situations. While the process is ideal for second order situations, it must be emphasised that it is a second order process, first order situations with limited people involvement are better approached through the PSP.

Towards a Conclusion

We have argued in this paper that there is a need for a second order process of quality improvement to address second order situations. We have developed and tested a generic

model of such a process and reflected on its implementation. Our findings show that application of the second order process is suitable in situations requiring consideration of second order social aspects within systems. The process allows the understanding of others' to influence the final solution, exploring and combining understandings in ways not possible with the first order PSP type approach.

The second order process does have drawbacks. Trials have proved that improvement team formation is critical to success. Firstly, the process relies upon building trust within the team. Trust enables true dialogue and exchange of ideas to take place. If trust is not present then the process will fail, people will be reluctant to speak freely thus, understanding of others' views cannot develop. The steps of the system can still be used however, the richness understanding brings will be missing. The hierarchical levels of the team plays a role in the development of understanding. Team members may trust each other but if some members are at a significantly higher level, those members' views will take president. However if the team is chosen with care the process has proved as the case study shows to be highly effective. The steps build the understanding of the situation and of other people. For second order applications, the process should be used in preference to the PSP.

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Towards a Second Order Research Methodology

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Abstract

This paper addresses the need for re-examining the cognitive perspective on the role of language in social research. From the autopoietic perspective, language is not a tool to reveal an objective world; rather language is a venue for action, coupling the cognitive domains of two or more agents. Responsible research enquiry would seek to create systemic communication practices that allow the co-existence of differing understandings within. Creating a dialogue for exploring and emerging meaning is essential in developing understanding and validating the research results.

Keywords: autopoiesis, social systems, language, dialogue, research method, systems thinking

Introduction

The application of any research methodology without reflection on the underpinning assumptions is flawed. What is more, such an approach is bound to lead us to an incomplete understanding of the situation under consideration, since it places 'restrictions' on the ways we question the validity of the knowledge unearthed in the application of the methods. Thus, creative interpretation becomes limited. The paper considers this problem. It emphasises the importance of theoretical reflection and an epistemological perspective in exploring the assumptions underlying research designs. The discussion focuses in more detail onto the role of language in the research process.

Crotty (1998) suggests that the basic elements of any research process include methods, methodology, theoretical perspective(s) and epistemology. Thus, it is essential for any rigorous research attempt to clarify and explore the answers to the questions:

- What methods (techniques, procedures, i.e. interviews, observations, etc.) are to be used?
- What methodology (strategy, plan of activity, process of design, i.e. ethnography, action research, etc.) governs our choice of methods?
- What are the theoretical (philosophical) perspective(s) of looking at the world and making sense of it (i.e. systemic thinking, complexity theory, theory of language, etc.) that influence our logic and criteria and provide context for applying the methodology?
- What epistemology grounds the theoretical perspective(s)?

The above questions and any proposed answers are interlinked and are best considered as mutually determined.

The intention of this paper is to go beyond simple answers and explore epistemological and other theoretical perspectives within the context of research design, based on a rigorous understanding of the human condition (that is, our way of being human) in both its biological and social embodiments. It is the theory of autopoiesis that offers such an

understanding. The paper focuses on an autopoietic perspective on knowing, the role of language, and the systems approach.

Autopoiesis, Experience and Knowledge

It is through our particular way of being that we act as observers. Thus, everything we say (even to ourselves), is said by one observer to another. Consequently, our capacity to distinguish and therefore, our knowledge, depend upon the make-up of the particular observer.

Since the observer is a living entity, a 'true' insight into the domain of knowledge requires an understanding of cognition that takes into consideration the biological phenomenon and is mindful of the observer's role within it. The theory of autopoiesis is based on explaining the generative process of the living. Autopoiesis is the mechanism that defines the manner in which a living system exists as a distinguishable entity (Varela, 1996).

An autopoietic system is a network of processes for production of components that:

1. Through their interaction and transformations continuously, regenerate the network of processes that produced them;

2. Constitute the entity as a concrete unity in the space by specifying the topological domain of its realisation as such a network (Maturana and Varela, 1980).

Consequently, an autopoietic system that exists in a physical space can in general be thought of as a living system.

Autopoiesis is basic to the living individual. What happens to the individual is subservient to its autopoietic organisation, for as long as it exists the autopoietic organisation remains invariant (Varela, 1979). What this means, is that the living individual is an autonomous entity that actively maintains its identity. Its identity and therefore its emergent global properties are generated through a process of self-organisation within its network of components. A two-way process of local-to-global and global-to-local causation (Figure 1) conditions this process of self-organisation.

Figure 1 The Mutual Embeddedness of Component Dynamics, Autopoietic Entity and its Environment.

Firstly, there is the local-to-global determination ('upward' causation) through which the entity, with its properties, emerges. Secondly, however, there is global-to-local determination ('downward' causation), where global characteristics constrain or direct local interactions between the components (Varela, 1979). For example, in organisms with a nervous system, the rules of interactions within the neuronal network are in reciprocal relationship with the overall activity of the autopoietic entity. Largely, behaviour is a regulator of perception. That is to say, what the organism senses is a function of how it behaves, and how it behaves is a function of what it senses. Situated behaviour, thus, takes the form of coupling (often referred to as 'structural coupling') with the environment, where environmental perturbations trigger changes in the entity but do not determine them, because changes in autopoietic systems are necessarily subservient to conservation of identity.

The dialectics of the living are based on the necessary emergence of a meaning relevant to the perspective of the cognitive self (for example one's perception), and on a coupling with the environment which refers to the necessary dependence of the self on its environment (for example socio-linguistic interactions). Consequently, the contents of human experience (how the world appears to us); depend crucially on the mutual embeddedness of the neuronal dynamics (included in the overall physical and chemical dynamics), the human agent as a unity with global properties (body, mind, consciousness, self and so on) and, the environment. Thus, human experience is personal but not private. Experience is clearly a personal event, but that does not mean it is private, in the sense of some kind of isolated subject that is parachuted down onto a pre given objective world. This irreducibility of human experience, from the duality portrayed by the embodiment and the situatedness of the human agent, cannot be underestimated when developing approaches or methodologies for research (Varela, Thompson and Rosch, 1991).

Autopoiesis and the Role of Language

The coupling of a living organism with its environment may include interacting with other organisms and if the interacting organisms reciprocally select each other, their respective paths of ontogenic structure changes, generating a domain of communicative interactions. The individual ontogenies of the participating organisms occur as part of the network of co-ontogenies that comes about in constituting higher order or social unites.

> *'As observers we designate as communicative those behaviours which occur in social coupling and as communication that behavioural co-ordination which we observe as a result of it'.* (Maturana and Varela, 1987)

This consensual domain of communicative interactions in which behaviourally coupled organisms orient each other with modes of behaviour, whose internal determination has become specified during their coupled ontogenies, is a linguistic domain. The name 'linguistic domain' was chosen because such learned communicative behaviours constitute the basis for language, although they are not identical with it. The conduct of each organism is internally determined by its autopoietic structure; however, the conduct of one organism is a source of perturbations for the others while the coupling lasts. The linguistic domain, therefore, is intrinsically non-informative, although the observer may describe it as if it were so. What determines the interaction is the dynamics of structural coupling of the interacting organisms.

Such a view contradicts the more traditionally established metaphor of 'the transmission of information', in which, communication represents something generated at a certain point, carried through an information channel and delivered to a receiver. This metaphor is not correct, since biologically there is no transmitted information. (Krippendorff, 1997) Moreover, it presupposes that what happens to the receiver (listener) is predetermined only by the perturbing agent (sender). In fact, however, communication depends on not only what is transmitted, but also what happens in the organism that receives it. Communication, therefore, is a matter of mutual orientation, primarily with respect to each other's behaviour, and secondarily with respect to some subject (Maturana and Varela, 1980).

Therefore, language is a venue for action, coupling the cognitive domains of two or more actors. Language should not be regarded as a system of symbols that are composed into patterns that stand for things in the world and thus reveal our 'objective' knowledge of it. Words are tokens for linguistic co-ordination of actions and not things we move from one place to another. Thus, it is appropriate to discuss languaging as an act rather than language as a symbolic notation. Since we exist in language, the domain of discourse that we generate becomes part of our domain of existence and part of the environment in which

we conserve identity and adaptation. As observers, we live in a domain of recursive discourse. Thus, the unity of the human society is generated through the network of conversations that language generates and which through its closure generates language itself. Social systems exist, for their members, in co-creating reality. Where language agreements decide what is true and what is false:

> *' Human agreements decide what is true and what is false? It is what human beings say that is true and false; and they agree in the language they use. That is not agreement in opinions but in form of life'.* (Wittgenstein, 1967)

Thus, meaning becomes fundamentally social and language becomes part of everyday being in the world. The world is continuously innovated generating new possibilities through communication. Thus, by its design the communication structure needs to be open to evolution in order that it can accommodate and promote new opportunities. Autopoietic theory reintegrates the individuals as the fundamental creators of the communication structure.

It is through languaging that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together. Bohm (1987) suggests that a new type of dialogue is needed in human communications. The basic idea of this dialogue is to be able to talk while suspending your opinions, holding them in front of you, neither suppressing nor insisting upon them, not trying to convince but simply to understand. We must perceive all the meaning of everybody together, without having to make any decisions or saying who is right or who is wrong. It is more important that we all see the same thing.

In this way, an organisation is able to take conversations and collective practices to a deeper level. The form of dialogue, suggested by Bohm (2000), encourages opening up and engaging in listening without a particular purpose, listening for the sake of hearing what other thoughts and opinions there are, what is being said, whilst trying consciously to suspend our assumptions and judgements. It is building awareness of what there is to be heard without focusing on it through the lenses of our judgements and assumptions. This 'listening' increases our chances of becoming sensitive and thus, able to hear the prejudices of agents outside ourselves.

This form of dialogue should be seen as a core element within any human enterprise, as it creates the context for all activities, rather than (as may be suggested by more traditional communication approaches) being merely part of the chain of activities. Dialogue is about involvement, about co-creation and communication. Therefore, a generative dialogue process in organisations will enhance their capability of developing a meaningful language providing a valid venue for action and continuous learning.

The Systems Approach, Autopoietic Epistemology and Language

Insights from the systems thinking tradition are considered helpful in providing a holistic perspective. The systems thinking approach makes conscious and formal use of the concept of wholeness, as captured in the word system. The concept of a 'system' embodies the idea of a set of elements dynamically related in time. Each of which can affect the performance of the whole (Beer, 1979) however, none of which can have an independent effect overall (Ackoff, 1994). The system exhibits as a single whole, emergent properties which have no meaning in terms of the parts of the whole (Ashby, 1956).

'The system concept, the idea of a whole entity which under a range of conditions maintains its identity, provides a way of viewing and interpreting the universe as a hierarchy of such interconnected and interrelated wholes'.(Checkland, 1981)

These definitions embody an approach that, unlike the reductionist methodologies, encourages an exploration of the relationships between elements, rather than concentrating on the properties of the individual elements themselves, therefore considering performance in terms of the systems structure (Senge, 1990). Further, there is an implication that systems are governed by the dynamic interactions of their components, a system's conduct is classified and analysed through the 'patterns of its behaviour', or its 'trends', rather than through seeking to predict events. This systemic perspective encourages 'closed loop thinking', where we are looking for continuing interrelated processes, rather than one way relationships (Ackoff, 1978).

The Systems Approach includes a set of theories that attempt to rigorously explore, analyse and diagnose systems behaviour, i.e. Viable Systems Model (Beer, 1979), Soft Systems Methodology (Checkland, 1981), Systems Dynamics (Senge and Sterman, 1992; Forrester, 1994), complexity and emergence (Nicolis and Prigogine, 1989).

The Systems Approach has proven its merits (Flood and Jackson, 1987). It is not the purpose of this paper to discuss them. What is important to reflect on in order to clarify our theoretical stance is, the observer has to be included as part of the system.

The most basic cognitive operation we perform as observers is the operation of distinction. It is through the operation of distinction that we specify a unity as an entity distinct from its background (Maturana and Varela, 1987). We characterise both the unity and the background with the properties with which the distinction endows them and specify their separability. If the observer applies the operation of distinction recursively and, thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of systems. The autopoietic epistemological perspective suggests that cognition (the distinctions we make) is conditional to embodiment. The act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, and not simply the act of processing what is objectively to be 'seen'. Thus, systems are epistemological qualities and not definitions of how things actually are or occur. Different observers perceive or describe systems, and therefore, their boundary and their structure differently. The observer has to be accounted for as part of any explanation. Nevertheless, systems have become the means by which we explore and describe the consistency of situational behaviour. Therefore, descriptions of system structures are useful tools and, if some form of agreement can be reached about 'what a system does' then it is possible to communicate about its structure and boundaries with greater (in relative terms) coherence. Language needs to take account of a systemic vocabulary.

The definition of a system is a dynamical activity. It involves both objective and subjective reality and the cycle of perception and action, that unites them. Indeed, the definition of the system is likely to change in a whole host of ways when new distinctions are identified and become relevant. Thus, any attempt to freeze the definition of any system stifles creativity. It constrains knowing by forcing new explanations to be built on frozen categories, as though these were absolute truths given in nature rather than specified by us. Systemic language should continuously evolve and reinvent itself.

A Second Order Research Methodology

Having realised that perceptions of the same observation vary between observers and that systems themselves are dynamic and therefore changing. A second order research methodology is required to understand any given situation. This second order methodology seeks to understand the perceptions and opinions of the actors within the system under investigation as a primary activity, in this way developing understanding of the dynamics of the systems under investigation. Such a methodology is show in (Figure 2).

Second order methodology follows the recursive systems principles of Beer(1979). It is important that as many levels of recursion are considered as needed to encompass the organisation as a whole. Use of the process is in second order situations, where understanding of others understanding is required

The process outlined is iterative. It is a closed cycle of exploring, reflecting and developing language in dialogue. It requires that employee's participate in the process as researchers in their own right. In fact, the principle of employee's participation is crucial to the success and continuation of the process.

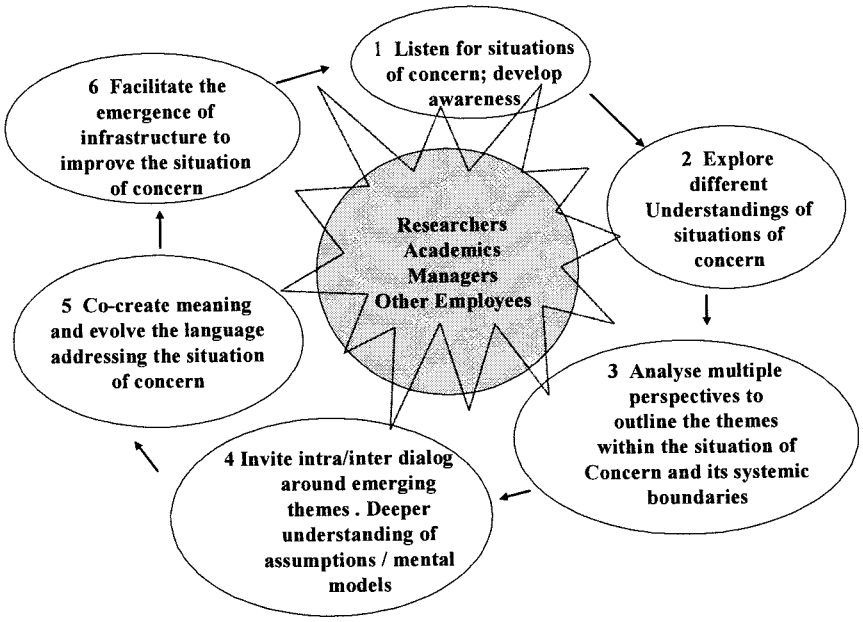

Figure 2 A 'Second Order' Methodology

The individual stages 1-6 (Figure 2) are developed below:

1. Listen for situations of concern; develop awareness

Developing awareness is essential and the starting point of the process. Awareness' can spring from many sources. Activates considered prime candidates for developing awareness include meetings of all descriptions, organisational reviews, quality audits, reports, customer and employee surveys to name but a few.
Observing, experiencing, sensing, informal and formal communication practices (meetings, conversations, dialogue groups). These can feed into the emergence of situations of concern; this may be facilitated by managers and/or academics.
'Volunteer' researchers (employees, managers and or academics) meet key actors in the situation of concern (senior management and/or middle management, senior sponsorship is sought). A volunteer steering team emerges with a project leader that can facilitate effective communication within team and with other stakeholders. A project plan is

outlined with regard to exploration, interviews, observations, meetings, and updated on a short-term basis.

2. Explore different understandings of situation of concern.

Within stage 2, the research explores differing understanding of the situation. People base their thinking and therefore conclusions and subsequent actions on preconceived beliefs. No matter how strange those beliefs seem to others' (Fish 1985). The team undertakes an examination of their varying views of reality, neither accepting nor rejecting them. Looking without judgment, accepting the views of others' exist and for them constitute reality.

Several recognised research methods can be employed within stage 2 these could include semi-structured interviews. For this, two researchers are more effective with one leading the interview with general questions and the other concentrating on peripheral matters arising from the main questions. In this way with few main topics, a richer picture can emerge allowing exploration and further analysis.

Dialogue groups with stakeholders are another approach; these sessions can be conducted by members of the project team or with the help of professional facilitation. Informal conversations and formal organisational meetings are also sources of research data. Intranet discussion forums allow individuals to partake in virtual discussion groups at time and place that suit themselves. A mixture of the above methods suited to the situation and system can be employed to provide research material that is used to develop an initial awareness and understanding of the situation(s) of concern.

3. Analyse multiple perspectives to outline the themes within the situation of concern and its systemic boundaries

Cross analysis of interviews by at least two researchers and if the subject is of high importance three is used to identify emerging themes of concern and identify the system boundaries as seen by the interviewees. Software tools such as Nudist or Atlas may be used to contribute to the language analysis however such tools are an assistance rather that a necessity. Whatever form of analysis is employed the outcomes should be an emergence and agreement within the organisation members of the theme(s) of concern and the system boundaries. Once emerged a recursive structure such as the Viable System Model Beer (1979) may be used to give a holistic systems approach.

Analysis of the multiple perspectives held by the team allows the underlying themes and varying concerns to be established. Churchman (1970) maintains that a wide analysis will produce a rich and complex picture. However, Ulrich (1983) points out that the purpose of the analysis will impose restrictions.

4. Invite intra/inter dialogue around emerging themes. Deeper understanding of assumptions/mental models

This stage seeks to deepen and increase shared understanding. The aim is to arrive at a view of reality shared by the team that incorporates, while clarifying varying realties.

Section 4 may include systems thinking development workshops to share insight into systemic analyses and issues for dealing with complexity
Reflective dialogue is also a useful method if utilised around assumptions and insights from stage 3, representing a shared understanding not individual feedback.

It may be necessary to utilise professional facilitation within dialogue groups (Bohm's dialogue practices) in order to develop the focus to explore underlying assumptions and creation of shared meanings.

An important part of this stage is exploring and bringing into the open mental models, beliefs and assumptions. This is not an easy task but can be achieved with the use of influence diagrams (from systems dynamics), story telling, narratives, art, etc to bring into the open mental models beliefs and assumptions. Simulations models can be used as what-if micro worlds. The outcome from Section 4 is a deeper understanding of others and the system dynamics including underlying or hidden beliefs, assumptions and factors that affect the system

5. Co-create meaning and evolve the language addressing the situation of concern

As human beings, we communicate and conduct our lives through language. Organisationally we use many languages, the language of the boardroom, the workshop, technical languages, etc. Most are full of terminology unknown to people outside the particular discipline. For the development of meaning leading to understanding, a common language understood by all is required.
Habermas (1976, 1984a, 1984b) discussing language and speech acts, points out that a shared language makes communication possible, that people then pass information and reveal their inner thoughts, while establishing interpersonal relationships.

Section 5 utilises dialogue sessions in order to gain deeper an understanding of developing beliefs and insight primarily to identifying and bring to the surface issues that need addressing. In addition, section 5 is used to evolve a common organisational language to deal with the situation(s) of concern (Krippendorff, 1997).

6. Facilitate the emergence of infrastructure to improving the situation of concern

Section 6 concentrates on facilitation to develop the emergence of infrastructures, strategies and implementation teams bases on insights and recommendations from section 5 One such approach that may be utilised is 'Deep Slice', in 'Deep Slice' teams with both a vertical and horizontal element give a departmental as well as organisational approach to section 6.

Department A	**Department B**	**Department C**	**Department D**
Department Head	Department Head	Department Head	Department Head
Supervisors	Supervisors	Supervisors	Supervisors
Specialists	Specialists	Specialists	Specialists
Implementers	Implementers	Implementers	Implementers

Table 1 'Deep Slice' approach
(Source Knowledge Management Workshop Presentation given by Professor David Weir at Draeger Safety UK, 3rd & 4th August 2004)

As can be seen from Table 1 deep slice teams have a vertical departmental based element. Vertically each team has members from all levels of the departmental championed by the departmental head. Members of other departments can be utilised as consultants if and when appropriate. The horizontal or organisational element is formed from teams at similar organisational levels such as departmental heads etc. The horizontal element brings the cross-departmental communication and exchange of ideas and opinions allowing an organisational wide holistic view. Thus, 'Deep Slice' provides the means of developing teams to address the outcomes of section 5 in a manner best suited to the organisation and situation(s) of concern.

The research process is an ongoing learning process. Stages 1-6 do not necessarily follow in order often being interlinked in multiple ways.

This methodology is based on insight from theory and practice. It has and will be continually revised and amended, as understanding grows. Developing and evolving in pace with the changing systems

This framework recognises and promotes organisations as evolving structures and looks at order as dynamic rather than static.

Setting the Context for the Proposed Methodology, Structure and Order

This section outlines our understanding of the nature of organisations and thus provides the context for the use of the methodology.

It is vitally important to set up the context and reveal the assumptions in relation to understanding the nature of organisations as they condition our thinking. To gain understanding, researchers must be aware of the underlying assumptions and beliefs that drive the system that is the organisation.

Organisations are evolving structures; there is a need to clarify the interplay between structure and order.

Structure suggests some order. Order broadly speaking is related to recognised distinctions, arrangements and linkages between elements within one or many dimensions. Could this be the reason why implicitly we refer to structure as something static? However, a much deeper set of questions are, how is it that structure originates and grows, how is it sustained, and how does it finally dissolve? That is, how is the order sustained, changed, created or destroyed? Structure is dynamic and should be better referred as structuring, while relatively stable products of this process are structures (Bohm & Peat, 2000).

Recognising that it is structuring that is important rather than structure in itself is a revealing insight. What follows is a realisation that order is also dynamic and that our perceptions of order change in the continuous cycle of interaction between the subject and the object of knowing. The problem, however, is that in practice we often act as if the order that we perceive is a given or absolute reality. Very often social groups and societies work with categories of distinction upon which they implicitly agree, and because these categories are valid for the majority, they are accepted as if they have some sort of objective existence. This is dangerous because when the context of inquiry changes and new perceptions of order are needed, the mind tends to cling to these old perceptions since these are what have been accepted. Such implicit conventions of order, when held fixed, stifle creativity. Moreover, they can lead to a breakdown in communication between the supporters of the new emerging perceptions of order and the stabilised or well-accepted perceptions of order. This, of course, is because we tend to reinforce our concepts and beliefs as though they are absolute and in so doing we choose to fragment 'the world' from ourselves, without recognising that, we are participants in its creation.

What we need to remember is that our concepts and their meanings are moulded by the activities of our everyday life within our social group or society. When the context of this society changes new, categories are needed. Thus, working with the old set of concepts within the new context will more often than not result in inappropriate behaviour. In essence, our ordering of 'reality' influences how we live and our way of life gives meaning to our concepts. It becomes clear, therefore, that we should adopt fluid rather than fixed perceptions of structure and order.

Our Western culture embraces the perception of static order. Consequently, we implicitly believe that we can find an order (or a structure) that explains the behaviour of the system; or that we can conjure and implement an order that generate the behaviour that we want to achieve. It is the assumed position that the world is governed by orders that we call laws. Moreover, if we discover these laws we can explain, manage, control and even create systems to obey them: God has created the universe according to his order, thus, it is the job of the managers to create and govern organisations according to their

understanding of order. Authors such as Nicolis and Prigogine, however, consider such a premise to be a misconception (Prigogine & Nicolis, 1989). They contend that man must have looked for the power of creation in the wrong place and, because of this, created the domination of one person's will over the others; and an order of human enterprise where control and rigid structures are the norm. The power of creation, as studies in deterministic chaos have shown, lies within what is being created, within the building blocks and their communication with each other. 'As there is no one to build nature we must give to its very elements the microscopic activity, a description that accounts for the building process' (Prigogine & Stangers, 1984).

The phenomenal domain of human enterprises is realised through the network of interactions between the human actors. Stacey, in interpreting the impact of chaos theory on management paradigms argues that such networks through local agent interactions are capable of spontaneous self-organisation, to produce emergent orderly, evolving patterns of behaviours of the network without any prior comprehensive system wide blueprint for the evolution of the system (Stacey, 1992). It is clear, therefore, that bestowing on managers the sole responsibility for the design of the rules and structures of their organisation is a perilous route based on a fragile illusion. The dynamics are determined by the pattern and nature of the actor's relationship. What's more, the response to any perturbation is determined by these very dynamics. Stabilising the behaviour of the network means simply repeating the past. When operating in the chaotic region, however, the network is capable of rapidly recognising fluctuations in the environment and generating flexible behaviours in response. The 'tuning' of the network in response to these perturbations is accomplished through continuous evolution of the structure. This is what Maturana and Varela (Maturana and Varela, 1987) define as adaptation and learning. The flexibility to learn and innovate in turbulent environments is essential. Far from equilibrium, organisations begin to perceive the smallest changes in the environment or, indeed, inside themselves. Further, since only variety absorbs variety, organisations respond by self-organising themselves to react to fluctuations and to adapt to the environment. There are multiple paths from which to choose. Dissipative structures emerge that promote alignment with the environment. New order and possibilities for future development arise from amplification and exploitation of fluctuations.

Indeed, the concept of the dissipative structure has thrown light on the role of the manager, as one of a conductor of communication, promoting coherence in the enterprise activities and the exploration of new horizons. It is by organising the system to work in the chaotic region that high sensitivity to perturbations in the environment can be achieved and orderly behaviours can emerge and evolve through mutual re-enforcement. Managers can exploit the chaotic characteristic of behaviour by looking for conditions that will allow small efforts to produce a significantly variable spectrum of appropriate behaviours. The future emerges through spontaneous self-organisation and there is no alternative but to make the change and see what happens, to discover where you are going as you are getting there. We are looking for order that allows change and flexibility. We are looking for meditative organisations that promote listening and continuous tuning with the environment. In chaotic systems, the issue is not simply one of finding the answers, but in general one of knowing the questions. In the face of uncertainty, we cannot know what we do not know. Therefore, any study should be conducted according to which institutional form (or forms) is best able to contend with the unknowable future. The institutional form, thus, needs to be able to match the ever-changing variety of the environment. If the environment is changing quickly, and we cannot predict these changes well in advance, we need autonomous and spontaneously self-organising systems. In a chaotic world, there is no knowledge of either future problems or their possible solutions. Therefore, our management policies should be concentrating on the means rather than the end (Sice, Mosekilde and French, 2000). In addition, as the operation of coherence in social systems, is realised through communication, special attention should be given to the linguistic

domain, to variety of the language and to the patterns of the conversation network of organisations.

Concluding Remarks

Research into social systems inevitably involves and relies on human communication.

The communication process involving the researcher and other actors that are the object of research inevitably changes to a lesser or larger degree the initial perspective, assumptions and opinions of all those involved. It is ethically and practically important that this communication process is a focus of reflection in the research enquiry.

Although social scientists communicate in numerous ways, interviewing their subjects, engaging discursively with others, publishing their work, and thus continuously engaging in language, self- reflection on the application of language theory is surprisingly rare in the literature.

Languaging surely affects our perceptions, how we create a world, and in that world what becomes real to us. Without an awareness of our languaging we are, as Heinz von Foerster (1979) noted, double blind: We do not see (certain things that other language uses could bring forth) and we do not see our not seeing this.

The cure for such blindness lies in consciously deviating from established linguistic practices, for example, by inventing a new vocabulary, by introducing new metaphors or by creating different communities to language. 'Second order' research methodologies are needed to bring into consideration the importance of 'second-order' understanding and the role of language in creating reality. In a second order philosophy the employees are engaged as researchers, it is not action research conducted by a third party but research conducted by the individuals involved with input from a third party. Research that can be carried on by the employees, providing the innovative drive and continued improvement, enlisting the help of consultants and academics as and when required to fill the role of facilitator with the required fields of expertise identified by the employees themselves. It is the act of turning employees into researchers, who understand the dynamics of there own organisation. Along with input from academia acting in the role of consultants and facilitators, that brings the second order and the innovation to this approach. It is the members (managers and employees) of the organisation that define the area of concern, develop the language, analyse the findings and develop the action plans that from the solutions.

Organisationally it must always be remembered that evolution is a continuous process as already stated in section 6, structure and order are not static they adapt themselves to changing environmental conditions, reacting to the perturbations received from the external environment. To think of structure and order as static is a mistake, stifling adaptation by clinging to outmoded order and structure can only cause standstill in organisational evolution. With the speed of external environmental change allied with the growing unpredictability of change, the realisation that organisations should be considered as evolving systems is important. For organisations, the saying *"evolve or die"* is more important today than ever before.

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An Autopoietic Perspective into Cognition and Language in Social Systems Research: a Study of Quality Enquiry at Draeger Safety UK

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Abstract

This paper addresses the need for re-examining the cognitive perspective on the role of language in social research. From the autopoietic perspective, language is not a tool to reveal an objective world; rather language is a venue for action, coupling the cognitive domains of two or more agents. Responsible research inquiry would seek to create systemic communication practices that allow the coexistence of differing understandings within. Creating a dialogue for exploring and emerging meaning is essential in developing understanding and validating the research results.

Keywords: autopoiesis, social systems, language, dialogue, research method, systems thinking

Introduction

The application of any research methodology without reflection on the underpinning assumptions is flawed. What is more, such an approach is bound to lead us to an incomplete understanding of the situation under consideration, since it places 'restrictions' on the ways we question the validity of the knowledge unearthed in the application of the methods. Thus, creative interpretation becomes limited. The paper considers this problem. It emphasises the importance of theoretical reflection and an epistemological perspective in exploring the assumptions underlying research designs. The discussion focuses in more detail onto the role of language in the research process.

Crotty (1998) suggests that the basic elements of any research process include methods, governing methodology, theoretical perspective(s) and epistemology. Thus, it is essential for any rigorous research attempt to clarify and explore the answers to the questions:

- What methods (techniques, procedures, i.e. interviews, observations, etc.) are to be used?
- What methodology (strategy, plan of activity, process of design, i.e. ethnography, action research, etc.) governs our choice of methods?
- What are the theoretical (philosophical) perspective(s) of looking at the world and making sense of it (i.e. systemic thinking, complexity theory, theory of language, etc.) that influence our logic and criteria and provide context for applying the methodology?
- What epistemology grounds the theoretical perspective(s)?

The above questions and any proposed answers are interlinked and are best considered as mutually determined.

The intention of this paper is to go beyond simple answers and explore epistemological and other theoretical perspectives within the context of research design based on a rigorous understanding of the human condition (that is, our way of being human) in both its biological and social embodiments. It is the theory of autopoiesis that offers such an understanding. The paper focuses on an autopoietic perspective on knowing; autopoiesis and the role of language; and the systems approach, autopoiesis and language. The

theoretical discussion is brought into real life context through reflection on the research enquiry into the meaning of quality and quality improvement at Draeger Safety UK.

Autopoiesis, Experience and Knowledge

It is through our particular way of being that we act as observers. Thus, everything we say (even to ourselves), is said by one observer to another. Consequently, our capacity to distinguish, and therefore, our knowledge, depends on the make-up of the particular observer.

Since the observer is a living entity, a 'true' insight into the domain of knowledge, requires an understanding of cognition that takes into consideration the biological phenomenon and is also mindful of the observer's role within it. The theory of autopoiesis is based on explaining the generative process of the living.

Autopoiesis is the mechanism that defines the manner in which a living system exists as a distinguishable entity An autopoietic system is: a network of processes of production of components that produces the components that: (i) through their interaction and transformations continuously regenerate the network of processes that produced them; and, (ii) constitute the entity as a concrete unity in the space by specifying the topological domain of its realisation as such a network. Consequently, an autopoietic system that exists in a physical space can in general be thought of as a living system.

Autopoiesis is basic to the living individual. What happens to the individual is subservient to its autopoietic organisation, for as long as it exists the autopoietic organisation remains invariant. What this means, is that the living individual is an autonomous entity that actively maintains its identity. Its identity, and therefore its emergent global properties, are generated through a process of self-organisation, within its network of components. This process of self-organisation is conditioned by a two-way process of local-to-global and global-to-local causation (Figure 1).

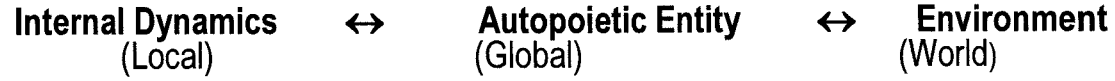

Figure 1. The Mutual Embeddedness of Component Dynamics, Autopoietic Entity and its Environment.

Firstly, there is the local-to-global determination ('upward' causation) through which the entity, with its properties, emerges. Secondly, however, there is global-to-local determination ('downward' causation), where global characteristics constrain or direct local interactions between the components (Varela, 1979). For example, in organisms with a nervous system, the rules of interactions within the neuronal network are in reciprocal relationship with the overall activity of the autopoietic entity. To a very large extent, behaviour is a regulator of perception. That is to say, what the organism senses is a function of how it behaves, and how it behaves is a function of what it senses. 'Situated behaviour', thus, takes the form of coupling (often referred to as 'structural coupling') with the environment; where environmental perturbations trigger changes in the entity but do not determine them, because changes in autopoietic systems are necessarily subservient to conservation of identity.

The dialectics of the living are based on the necessary emergence of a meaning proper to the perspective of the cognitive self (for example one's perception), and on a coupling with the environment which refers to the necessary dependence of the self on its

environment (for example socio-linguistic interactions). Consequently, the contents of human experience (how the world appears to us) depend crucially on the mutual embeddedness of the neuronal dynamics (included in the overall physical and chemical dynamics), the human agent as a unity with global properties (body, mind, consciousness, self and so on) and, the environment. Thus, human experience is personal but not private. Experience is clearly a personal event, but that does not mean it is private, in the sense of some kind of isolated subject that is parachuted down onto a pre given objective world. This irreducibility of human experience, from the duality portrayed by the embodiment and the situatedness of the human agent, cannot be underestimated when developing approaches or methodologies for research.

Autopoiesis and The Role of Language

The coupling of a living organism with its environment may include interacting with other organisms and if the interacting organisms reciprocally select in each other their respective paths of ontogenic structural changes, then they generate a domain of communicative interactions. The individual ontogenies of the participating organisms occur as part of the network of co-ontogenies that they bring about in constituting higher order or social unities. The observer designates as communicative those behaviours which occur in social coupling, and as communication that behavioural co-ordination he observes as a result.

This consensual domain of communicative interactions in which the behaviourally coupled organisms orient each other with modes of behaviour whose internal determination has become specified during their coupled ontogenies, is a linguistic domain. The name 'linguistic domain' was chosen because such learned communicative behaviours constitute the basis for language, although they are not identical with it. The conduct of each organism is internally determined by its autopoietic structure, however, the conduct of one organism is a source of perturbations for the others while the coupling lasts. The linguistic domain, therefore, is intrinsically non-informative, although the observer may describe it as if it were so. What determines the interaction is the dynamics of structural coupling of the interacting organisms.

Such a view contradicts the more traditionally established metaphor of 'the transmission of information', in which, communication represents something, which is generated at a certain point and carried through an information channel, or conduit, and delivered to a receiver. This metaphor is not correct, since biologically there is no transmitted information. Moreover, it presupposes that what happens to the receiver (listener) is predetermined only by the perturbing agent. In actual fact, however, communication depends not only on what is transmitted, but what happens in the organism that receives it. Communication, therefore, is a matter of mutual orientation, primarily with respect to each other's behaviour, and secondarily with respect to some subject.

Thus, language is a venue for action, coupling the cognitive domains of two or more actors. Language should not be regarded as a system of symbols that are composed into patterns that stand for things in the world and thus reveal our 'objective' knowledge of it. Words are tokens for linguistic co-ordination of actions and not things that we move from one place to another. Therefore, it is appropriate to discuss languaging as an act rather than language as a symbolic notation. We are constituted in language in a continuous becoming that we bring forth with others. Since we exist in language, the domain of discourse that we generate becomes part of our domain of existence and constitutes part of the environment in which we conserve identity and adaptation. As observers we live in a domain of recursive discourse. Thus, the unity of the human society is generated through the network of conversations that language generates and which through its closure

generates language itself. Social systems exist, for their members, in co-creating reality where language agreements decide what is true and what is false. Thus, meaning becomes fundamentally social and language becomes part of everyday being in the world: 'so you are saying that human agreements decide what is true and what is false? It is what human beings say that is true and false; and they agree in the language they use. That is not agreement in opinions but in form of life' (Wittgenstein, 1967). It is communication what continuously innovates the world and generates new possibilities. Thus, by its design the communication structure needs to be open to evolution in order that it can accommodate and promote new opportunities. Autopoietic theory reintegrates the individuals as the fundamental creators of the communication structure.

It is through languaging that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together. Thus, Bohm (1987) suggests that a new type of dialogue is needed in human communications. The basic idea of this dialogue is to be able to talk while suspending your opinions, holding them in front of you, while neither suppressing them nor insisting upon them. Not trying to convince but simply to understand. The first thing is that we must perceive all the meaning of everybody together, without having to make any decisions or saying who's right who's wrong. It is more important that we all see the same thing.

In this way an organisation is able to take conversations and collective practices to a deeper level. The form of dialogue, suggested by Bohm (2000), encourages opening up and engaging ourselves in listening without a particular purpose, listening for the sake of hearing what else there is, what is it that is being said, whilst trying to consciously suspend our assumptions and judgements. It is building awareness of what there is to be heard without focusing it through the lenses of our judgements and assumptions. This 'listening' increases our chances of becoming sensitive and, thus, able to hear the prejudices of agents outside of ourselves.

This form of dialogue process should be seen as a core element within any human enterprise, as it creates the context for all activities, rather than (as may be suggested by more traditional communication approaches) being merely part of the chain of activities. Dialogue is about involvement, about co-creation, and communication. Thus, a generative dialogue process in organisations will enhance their capability of developing a meaningful language, a valid venue for action and continuous learning.

The Systems Approach, Autopoietic Epistemology and Language

Effective communication in organisations demands a holistic approach, that attempts to avoid the fragmentation of the social system. Insights from the Systems Thinking tradition are considered helpful in providing a holistic perspective. The Systems Thinking approach makes conscious and formal use of the concept of wholeness, as captured in the word system. The concept of a 'system' embodies the idea of a set of elements dynamically related in time, each of which can affect the performance of the whole (Beer, 1979), however, none of which can have an independent effect on the whole (Ackoff, 1994). The system exhibits as a single whole, emergent properties which have no meaning in terms of the parts of the whole (Ashby, 1956). Thus, 'the system concept, the idea of a whole entity which under a range of conditions maintains its identity, provides a way of viewing and interpreting the universe as a hierarchy of such interconnected and interrelated wholes' (Checkland, 1981).

These definitions embody an approach that, unlike the reductionist methodologies, encourages an exploration of the relationships between elements, rather than concentrating on the properties of the individual elements themselves and, therefore, considers performance in terms of the systems structure (Senge, 1990). Further, there is an implication that systems are governed by the dynamic interactions of their components: a system's conduct is classified and analysed through the 'patterns of its behaviour', or its 'trends', rather than through seeking to predict events. This systemic perspective encourages 'closed loop thinking', where we are looking for ongoing interrelated processes, rather than one way relationships. (Ackoff, 1978).

The Systems Approach includes a set of theories that attempt to rigorously explore, analyse and diagnose systems behaviour, i.e. Viable Systems Model (Beer, 1979), Soft Systems Methodology (Checkland, 1981), Systems Dynamics (Senge and Sterman, 1992; Forrester, 1994), complexity and emergence (Nicolis and Prigogine, 1989).

The Systems Approach has proven its merits (Flood and Jackson, 1987). It is not the purpose of this paper to discuss those. What is important to reflect on in order to clarify our theoretical stance is: the observer has to be accounted as part of the system.

The most basic cognitive operation we perform as observers is the operation of distinction. It is the operation of distinction by which we specify a unity as an entity that is distinct from its background. We characterise both the unity and the background with the properties with which the distinction endows them and specify their separability. If the observer applies the operation of distinction recursively and, thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of unities, systems. The autopoietic epistemological perspective suggests that cognition (the distinctions we make) is conditional to embodiment. The act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, and not simply the act of processing what is objectively to be 'seen'. Thus, systems are epistemological qualities and not definitions of how things actually occur. Different observers perceive or describe systems and, therefore, their boundary and their structure differently. The observer has to be accounted for as part of any explanation. Nevertheless, systems have become the means by which we explore and describe the consistency of behaviour of a situation. Therefore, descriptions of system structure are useful tools and, if some form of agreement can be reached about 'what the system does' then it is possible to communicate about its structure and boundaries with greater (in relative terms) coherence. Language need to take account of a systemic vocabulary.

The definition of a system is a dynamical activity. It involves both objective and subjective reality and the cycle of perception and action that unites them. Indeed, the definition of the system is likely to change in a whole host of ways when new distinctions are identified and become relevant. Thus, any attempt to freeze the definition of a system stifles creativity. It constrains knowing by forcing new explanations to be built on frozen categories, as though these were absolute truths given in nature rather than specified by ourselves through our enaction. Systemic language should continuously evolve and reinvent itself.

(Towards) a Research Design. The Draeger Case

The aim of this research is to explore the issues that relate to quality and quality improvement within the wider context including quality of work and working experience, this including quality of product and service. Also, because of the complexities of the

issues involved, it is not the intention to formulate our 'right' definition or recipe of quality, but to concentrate our attention on the philosophical (generic) framework of inquiry in which the issues of quality reside. To this end, a number of fundamental research questions have been identified that are as yet unanswered in mainstream quality research. These are:

- What, if any, are the criteria upon which to form an adequate quality definition?
- By what mechanism do we match the variety of the quality processes to those of the quality requirements as they constantly evolve and change.
- What are the dynamics of quality and how do these dynamics impact on different aspects of quality.

Currently, the work is at the stage of developing, piloting and reflecting upon a research process that would allow for exploring and emerging meaning with relation to the first research question: 'What, if any, are the criteria upon which to form an adequate quality definition?' A preliminary evaluation of the situation at Draeger Safety UK suggests that quality standards, requirements and results have to be communicated through various departments and managerial levels within an organisation. Language and the terminology used can vary; depending on the departmental language and degree of technicality involved and thus possibly change meaning on crossing departmental boundaries due to differing interpretations. The language of quality will naturally emerge as a result of the interactions and coordination of behaviours of organisational agents. A research enquiry into quality will need to engage the researcher in exploring the meaning of quality in dialogic interaction with organisational members. The enquiry itself will create a context for developing further interpretations and meanings.

The rational behind the research process is explained below. To do that we use Crotty's (1998) outline of the basic elements of the process: methods, governing methodology, theoretical perspective(s) and epistemology (as described in the introduction) but in reverse order: i.e. epistemology, theoretical perspectives, research methodology and methods.

Epistemology. What epistemology grounds the theoretical perspective(s)?

Our epistemology is grounded into understanding cognition from the perspective of autopoiesis. This perspective informs what is beginning to be known as enactive cognitive science (Maturana and Varela, 1987). It is founded in explaining cognition as a way of living. The dialectics of the living are based on the necessary emergence of a meaning proper to the perspective of the cognitive self and on a coupling with the environment which refers to the necessary dependence of the self on its environment.

The traditional view of cognition is based on the metaphor of inside - outside. The outside, or real world, is considered to be the source of information and the inside, or the brain is considered to be an intelligent processor of this information, with the mind embedded within it. In this metaphor our observations are merely representations of the outside that are thought to represent the truth and the brain, and the mind within, is the machine that works on these observations to extract knowledge. In contrast, autopoiesis and enactive cognitive science have moved away from this distinction between inside and outside. Cognition is conditional to embodiment and the ability of an individual to differentiate is thought to be a consequence of that individual's specific structure. Thus, the act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, and not simply the act of processing what is objectively to be 'seen'.

Whatever distinctions we make form our knowledge of the World. However, since our distinctions are generated through our interactions, then the content of our knowledge is

not simply a mapping of reality, but our way of living it. The knower is the ultimate point of reference. We apply divisions and distinctions in our thinking about the world. However, this fragmentation does not have an absolutely objective existence as our distinctions are epistemological qualities not 'true' realities.

Theoretical perspectives. What are the theoretical perspective(s) of looking at the world that influence our logic and criteria and provide context for applying the methodology?

The major theoretical contribution of the research is supposed be the development of a model of 'quality inquiry' based on a holistic (systemic) perspective, as opposed to the conventional reductionist perspectives usually employed, with a particular focus on the research questions defined above. This paper reflected on three areas of human knowledge currently providing the context for the research approach, i.e. systems thinking, autopoiesis and enactive cognitive science, theory of language and communication in organisations (Bohm 2000; Krippendorff 1997). It is possible that other areas of knowledge would be required to fully inform the research inquiry.

Methodology. What methodology governs our choice of methods? What methods are to be used?

The theoretical perspective outlined above demand that the research methodology (strategy) considers: language as a venue for action, language as source for innovation and language as window to understanding others.

Language as a venue for action

Linguistic interaction is a venue for action, coupling the cognitive domains of two or more actors (Whitaker, 1996). Therefore, it is often preferential to discuss languaging as an act rather than language as a symbolic notation. Language does not evolve just to take in an outside world. Therefore, it cannot simply be viewed as a tool to reveal that world. 'It is by languaging that the act of knowing, in the behavioural co-ordination, which is language, brings forth a world. We work out our lives in a mutual linguistic coupling, not because language permits us to reveal ourselves but because we are constituted in language in a continuous becoming that we bring forth with others' (Maturana and Varela, 1980). The knowledge of this knowledge constitutes the social imperative for a human-centred ethics' (Maturana and Varela, 1987). We have only the world that we bring forth with others.

Languaging as a way of bringing forth adaptation and innovation

We as observers live in a domain of discourse interacting with descriptions of our descriptions in a recursive manner and, thus, continuously generate new elements of interactions. The unity of the human society is generated through the network of conversations that language generates and which through its closure generate this same network of conversations. This operational coherence of our languaging together is what we experience as self and consciousness. Self-consciousness and awareness take place in language and as such they take place only in the social domain (Mingers, 1994). Thus, social systems must allow conservation of adaptation of human beings not only as organisms, but also as components of their linguistic domains (Maturana and Varela, 1987).
What this means that the search and development of new linguistic practices (new ways of langauging) is key to adaptation and innovation.

Dialogue as a window to understanding of others' understanding and for emerging of new language practices

Our understanding of someone else's understanding, recursively embeds another understanding into ours and thus becomes an understanding of understanding or a second-order understanding (analogous to Heinz von Foerster's (1979) notion of a second-order cybernetics). We adjust to what we hear, read, or experience, and we act in accordance with our construction of others' understanding.

A dialogue process offers a window to understanding other's understanding.
The dialogue process should be viewed as being the core element within any human enterprise, creating the context for all activities, rather than being merely part of the chain of activities. Communication is about the continuous orientation of behaviour of the actors and, thus, is about the creation of a common living space. Thus, it is important that we 'perceive all the meaning of everybody together, without having to make any decisions or saying who's right who's wrong. It is more important that we all see the same thing' (Bohm, 2000). The implication is that if we try to communicate blindly by imposing on the dialogue our assumptions and judgements without any attempt of clarifying together what we are talking about (without seeing the same thing), our languaging would not have the focus of mutual orientation. Therefore, just as Beer (1979) requires agreement to be reached on system conventions, agreement on what counts for exploring in the dialogue is vital for communication.
It is important to emphasise that this agreement is necessary but temporary and new ways of languaging should be sought to allow for innovation and adaptation.

The assumptions considered above are brought together in a learning research process presented in Figure 2

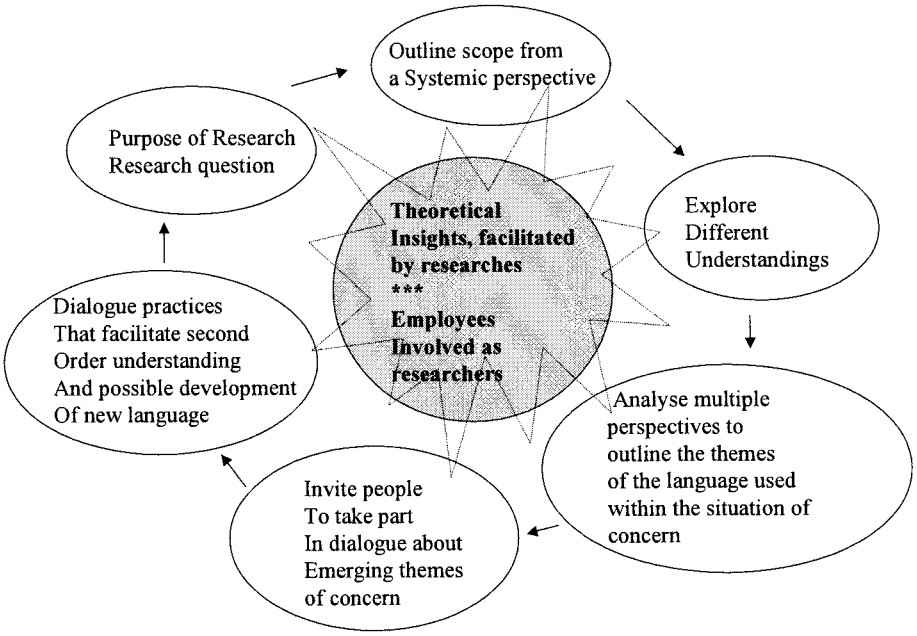

Figure 2. A 'Second Order' Methodology

Research methods. What methods(techniques and procedures) are to be used ?

As far as the choice of methods is concerned we are currently piloting a series of semi-structured interviews involving employees from a variety of activities. The purpose of the interviews is to explore what are the issues of concern related to quality of working life, quality of work, product and service. It is important that these interviews are very loosely structured and do not restrict the potential areas of concern. **A proposed interview structure is shown in Table 1.????** It is envisaged that some of the interviews and also observations are to be carried out by employees taking the role of researchers.
Observations and participation in problem solving activities is also part of the methods that would allow understanding and responsible participation.
Emergent dialogue groups to engage in exploring and developing new language are important in developing the linguistic model of quality.

Concluding remarks

Research into social systems inevitably involves and relies on human communication. The communication process involving the researcher and those Others (that are the object of research) inevitably changes (to a lesser or larger degree) the initial perspective of all involved. It is ethically and practically important that this communication process is a focus of reflection in the research enquiry.

Although social scientists communicate in numerous ways - interviewing their subjects, engaging discursively with others, publishing their work, and thus continuously engaging in language, self- reflection on the application of language theories is surprisingly rare in the literature.

Languaging surely affects our perceptions, how we create a world, and in what becomes real to us. Without an awareness of our languaging we are, as Heinz
von Foerster (1979) noted, double blind: We do not see (certain things that other language uses could bring forth) and we do not see our not seeing this.

The cure for such blindness lies in consciously deviating from established linguistic practices, for example, by inventing a new vocabulary, by introducing new metaphors or by creating different communities to language with. 'Second order' research methodologies are needed to bring into consideration the importance of 'second-order' understanding and the role of language in creating reality.

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LIFTING THE BARRIERS TO INNOVATION

A Practical View From The Trenches

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Abstract: *Draeger Safety UK based in Blyth Northumberland manufacturing breathing apparatus for the search and rescue market has been following the path to organizational learning for several years. So far, this path has entailed individual and group learning, leading to practical application of that learning and knowledge in innovative improvement projects and problem solving process. This paper examines the practical view from the trenches of the efforts of the organization at all levels to lift the barriers to innovation from several academic perspectives. These perspectives include Stafford Beer's Viable System Model, Peter Drucker's seven sources of innovation and Margaret Wheatly's argument that innovation means relying on the creativity of everyone within the organization. However, the purpose of Draeger Safety UK in cybernetic terms is survival through the generation of profit from its core activity of breathing apparatus manufacture. Therefore resources of both time and finance must remain balanced between the activities that produce today's profit and the innovation based forward drive to all round improvement that ensures tomorrows. Thus lifting the barriers to innovation is the conscious decision to utilise resources in equipping staff with the knowledge, tools and opportunities to enable innovation to take place. While at the same time the view from the trenches is the comparison of academic theory and practical reality.*

Key words: *Knowledge, Organizational learning, Viable Systems, Innovation*

Introduction

Some look on innovation as flashes of inspiration others just as hard work and planning. (Drucker, 2002) holds a position between the two leaning more to the hard work end of the spectrum. Arguing some innovation comes from flashes of genius, but most from a purposeful search for innovation opportunities. He holds the view that as with other organizational activity, innovation must be deliberately managed, targets set and results monitored. However he also maintains that innovation is more knowing than doing, being a special function of enterprise that must be committed to the systematic practice of innovation through knowledge.

Draeger Safety UK also holds this belief, having followed the path towards a learning organization for several years.

This paper examines the activities and results over these years to embrace principles of innovation through knowledge building, active participation and the development of trust at all levels within the workforce. The paper will utilise three themes to examine and place into academic context the practical activities carried out by the management and staff of Draeger Safety UK. The themes being Stafford Beer's Viable System Model, Peter Drucker's seven sources of innovation and Margaret Wheatly's argument that innovation means relying on the creativity of everyone within the organization. It is not the intention to give a definitive answer to organizational innovation; merely to examine the Draeger Safety UK approach. While this approach works for Draeger Safety UK within other organizations, it may not.

Innovation has many definitions including:

"Innovation is the successful exploitation of new ideas and is a vital ingredient for competitiveness, productivity and social gain within businesses and organizations."- ***London Innovation definition***

"The introduction of something new"- ***dictionary definition***

"An innovative business is one which lives and breathes 'outside the box'. It is not just good ideas, it is a combination of good ideas, motivated staff and an instinctive understanding of what your customer wants."
Richard Branson - *DTI Innovation lecture, 1998*

"Once you've worked on a truly innovative project you realise how important transformation is to the success or failure of a project. Your way of thinking changes your priority changes, your company changes and your way of working changes forever. True innovation is not just about changing a product, a service or even a marketplace it's also about recognising and realizing the need to change yourself." ***Ralph Ardill, Marketing & StrategicPlanning Director, Imagination*** - *London Innovation Conference, 2003*

Therefore within this paper innovation will be looked upon as any new product, method, or process that brings improvement and competitive advantage.

Today we live in an ever-changing world; a world where the speed of change increases every year and the need for organizations to adapt to change is not only important but also imperative to continued prosperity. An era requiring rapid change where to stand still is to fall behind, left behind in the survival race overtaken by competitors reacting to the requirements of change. Organizations are finding themselves on an exponential curve requiring ever faster adaptation and change (Wheatley, 2001). To survive organizations must change and adapt with ever increasing rapidity. The simple result of this requirement is that the acquisition and use of knowledge by individuals, groups and organizations, as the basis for innovation is becoming, if not already has become, an essential organizational survival tool.
Social anthropologists (Morris, 1967, 1969) tell us that people naturally wish to learn, explore new challenges, investigate new environments and adapt to changing conditions. This is part of human nature; in other words, people are natural innovators. In the past organizations have deliberately stifled natural innovation in the name of standardization, efficiency, predictability, reduction of variability etc to such an extent they have become barriers that must be overcome in today's rapidly changing environment.

Lifting the Barriers

Throughout both the private and public sectors traditionally several barriers to innovation have been in place. The challenge to senior management is in lifting these barriers. Barriers such as time allocation, finance, and innovational demarcation in the past have prevented involvement of all members of an organization in innovational activity. While the three barriers mentioned are not a full list. They form major obstacles to innovational progress.

The Time Barrier.

For individuals or groups to engage in learning and innovation, time allocation is required. If the organizational culture denies the need for allocation of time for such activities innovation is impossible.
Recently the move to the so-called lean mean organization has been in vogue. This has lead to in some cases to 'streamlining', 'downsizing' and other practices that in effect have reduced staff numbers and increased the workload for remaining staff. Some organizations have pursued this path to such an extent; reaction to change and innovation are virtually impossible. Staff being more than fully occupied in meeting daily requirements. In fact this practice has brought reengineering into disrepute (Willets, 1996). Leaving staff highly suspicious of management motives when introducing efficiency and effectiveness programs, reducing trust and further stifling innovation.
'*Lean is mean and doesn't even improve long term profits*' (Mintzberg, 1996)
For all staff to become enthusiastically involved as (Willets, 1996) maintains is the way forward to rapid innovation. The establishment of a trusting cooperative environment is a prerequisite. However, for increased trust time saved and improvements must be seen as beneficial to the whole workforce and not just management and profit.
At Draeger Safety UK, time is available for individuals to be able to engage in training and educational activities. This then leads to better understanding and if innovation is more knowing than doing (Drucker, 2002), thereby increases the innovation opportunities available within the organization.
This has enabled an enforcing systems thinking (Senge, 1990) feedback loop (Figure 1) to develop within Draeger Safety UK. Thus enabling learning and innovation with all members of staff becoming involved and being allowed the time to do so.

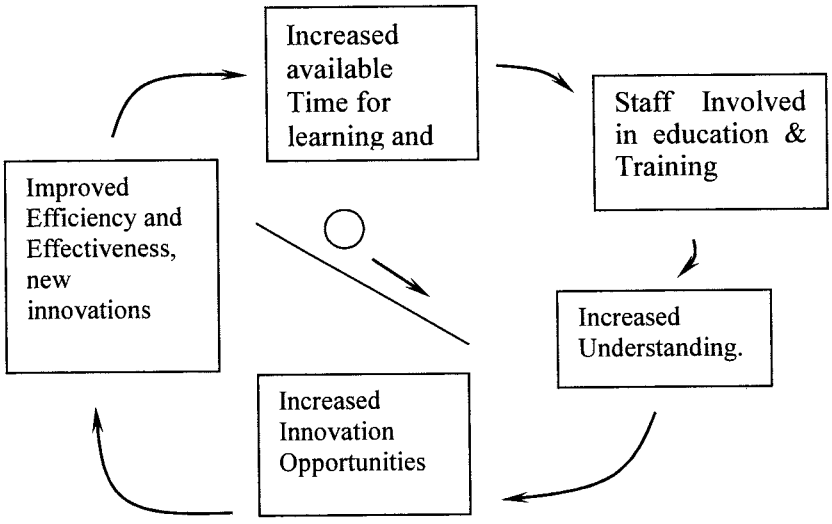

Figure 1
Positive Reinforcing Feedback Loop
(Senge, 1990)

The Positive Reinforcing Feedback Loop shown above demonstrates the systems thinking thought processes behind the personal and organizational learning within Draeger Safety UK. Time is available for people to partake in training and education. Thus increasing understanding of general operational, managerial and improvement principles as well as specific knowledge of products equipment and operations etc, this leads to increased understanding providing increased innovational opportunities.
Draeger Safety UK and specifically the operations department capitalize on such opportunity via kaizen groups, problem solving teams Draeger Best teams, (Draeger Best is a form of the European Foundation for Quality Management Model and practice EFQM) and action teams. This has resulted in a more involved workforce, increased trust and the empowerment of individuals. In addition, the formation in January 2003 of a dedicated team entitled the "High Performance Work Team". Consisting of four individuals drawn from Quality, Design, Assembly Supervision and Industrial engineering, providing cross-functional abilities, has increased the innovational potential within the company
The team's purpose is one of dedicated attention to management identified areas of concern where improvement is either required or desirable.
Any positive response loop such as that described above also has a balancing loop that is often unseen, forgotten or ignored (Senge, 1990). For example in the loop shown in figure 1, available time and innovation can not grow indefinitely, sooner or later a state of balance or equilibrium will be established by management or will naturally establish itself. When the loop is implemented innovations may increase slowly until staff generally recognizes the benefit, then increase more rapidly as use is made of the learning innovation time loop. However as the easily attained innovations 'or low hanging fruit picked as some writers have termed it' are attained the pace of innovation will slow and find a stable level. This level can be controlled and maintained via time and resource allocation in a managed environment or be allowed to establish itself at some arbitrary level in an unmanaged one. In an uncontrolled environment, this level can also change for what seems no apparent reason. It is far more desirable from a systems control respect that management determines and controls this level to suit the needs of the organization rather than allow arbitrary events to have affects in ways sometimes not visualized or desired.

The Innovation Demarcation Barrier.

Draeger Safety UK has also tackled the innovation demarcation barrier, the belief that "only designers, industrial engineers, managers, people with degrees etc are capable of innovative thinking" and therefore allowed the opportunity to become involved in innovation. Termed 'academic snobbery' by one senior manager. This belief stifles large possible sources of innovative creativity, can cause frustration and certainly lose organizations holding this view to innovation competitive advantage opportunities. The formation of the High Performance Work Team might form the impression that in fact Draeger Safety UK does believe in demarcation, where innovation and creative thinking is concerned. However, this team is in addition to, not instead of alternative innovational activities. In some cases with the 'High Performance Work Team' functioning as a resource or facilitation medium for other improvement teams. Management ensures that 'academic snobbery' in not considering suggestions and ideas from every level (especially operator's etc) is not allowed to happen.
Draeger Safety UK Operations manager (Vince Smith) has a favourite saying, "*with every pair of hands employed comes a free brain*". This has become an operation department philosophy and using and improving those free brains through training and education forms a major part of the operations innovational drive. The realization that any individual can have innovational ideas that are worth pursuing is accepted and followed. People are encouraged to partake in educational and vocational courses, contribute to kaizen and action groups etc. Recognition given via for example an operator of the month award,

carrying a small financial prize. Nominations for this award made not by management but operational staff. A committee made up of volunteer staffs, who decide on the recipient of the award, considers the nominations. Senior management also holds regular communication meetings (normally monthly) where staff can put forward ideas, suggestions and concerns. These meetings also allow senior management to signal the strategic direction, goals and priorities of the company. As a final example, a weekly brief contains financial information on sales and production output, Information of visitors to the company along with other general items of interest. Briefing sessions held by all supervisors and section managers again give staff an opportunity to give opinions, ideas or ask questions etc. These being directed to the appropriate member of staff or team for consideration and answer the following week. The discussed methods put into place by senior management. Ensure that staff has at least the opportunity to be informed as to company policy, strategic direction and has a platform for communication of ideas etc. that could lead to innovational improvements. These methods reduce to an extremely low level the possibility of 'academic snobbery' at Draeger Safety UK

The Finance Barrier

Innovation also requires finance, eventually any innovational activity brought to fruition and delivering benefit to the organization will require financial expenditure. This expenditure could be on equipment, material for trial production, external consultation etc. One of the functions of management is to make the decision as to which projects receive finance, and which do not. Draeger Safety UK has a philosophy of financing innovation whenever such ideas indicate possible improvement. However as with other organizations Draeger Safety UK must balance the finance required in pursuit of any project with the possible financial benefit that project will return. Management also has a responsibility to the originator of ideas etc rejected finance (or any other required resources) to communicate the reason for the idea not being pursued.

Quality also carries high priority; therefore, a project that maintains or improves quality receives finance, even if financial payback is not a result. An example of such a project was the development of an automated piece of equipment to insert high pressure sealing o-rings into a pressure reducer. Three colour-coded seals inserted in a specific order by hand had a possibility of error in insertion order. An action team formed from engineers and assembly operators being established to examine the situation and develop an answer that would eliminate the possible error condition.

The team first formulated the basic characteristics of the device. For example, it must be able to recognize colour, the order of the o-rings must be correct, the device should not insert the rings on error detection and all health and safety requirements must be established and met. This initial general specification then outlined the knowledge required, such as Programmable Logic Control (PLC) programming optical sensor use, control of pneumatic cylinders and knowledge of health and safety rules.

The requirement of PLC programming was unavailable within the organization and therefore required training and the purchase of software to enable generation of PLC programs via computer. While this required a financial expenditure, it brought new knowledge and the required capability to the company. In this manner, working through the requirements, discussing ideas and possibilities, a new process method and piece of equipment answered the initial quality sustainability question was developed by the team working together towards a common goal.

The final solution brought together pneumatics, programmable logic and optical equipment in a pokayoke device that recognizes colour and will not insert the seals, if they are in the wrong order or any are missing.

This device having no financial advantage in the form of improved cycle time, guarantees maintained quality of the operation and thus received the finance and resources of time and

manpower required. This example is a demonstration of as (Weatley, 2001) suggests *"The human capacity to invent and create is universal"*. Draeger Safety UK recognizes that people have innate capacity to innovate. All they need is encouragement, backing and engagement in meaningful issues.

The Seven Sources of Innovation

The question "is innovation inspiration or hard work", is posed by (Drucker, 2002)? With the conclusion that it is largely the latter. He identifies seven sources of innovation he comments *" In business innovation rarely springs from a flash of inspiration. It arises from a cold-eyed analysis of seven kinds of opportunities"*. These opportunities being:

1. Unexpected Occurrences.
2. Incongruities.
3. Process Need.
4. Industry and Market Changes.
5. Demographic Changes.
6. Changes in Perception.
7. New Knowledge.

The seven sources will effect various departments of any organization somewhat. The effect being dependant upon and varying according to departmental function. For example, process needs could have high impact on production departments while for sales and marketing this opportunity will have low innovational potential. Thus for some organizational departments some sources will be irrelevant. However put together they account for the majority of innovation opportunities within the overall organization.

Unexpected Occurrence

As one example of unexpected occurrence, the recent heightened threat from terrorist attack has increased the awareness of search and rescue organization to the need for additional standard as well as specialized equipment. In the case of one piece of specialized equipment, a requirement existed for fully working prototype to be available three weeks from first inquiry. During discussions with the leader of the project team, it emerged that a consolidated effort was required from all sections of the company to achieve the three-week deadline using rapid prototyping techniques. Design used high-powered drawing and modeling software (pro-engineer) to use existing components in new configurations. Production engineering and assembly personnel in actually building the apparatus, purchasing working closely with suppliers to secure purchased components and sales clarifying requirements with the customer.
It was only with the cooperation of all departments and staff that allowed a working breathing set to be available within the time limit.
As Wheatley (2001) states, most people are very intelligent. They have figured out how to make things work when it seems impossible, they have invented ways to get around roadblocks, they have created their own networks to support and help them learn. These acquired personnel networks come into their own at times such as the development and manufacture of the example above. The usual methodical laid down methods and steps in the development of new products within Draeger Safety UK had to be temporarily circumvented, while maintaining control of design integrity, quality etc. in order to meet such a short deadline. Impromptu meetings being arranged agreements being reached and work carried out when required. This type of unsuspected occurrence requires rapid response and adaptability from the whole workforce, as disruption to normal activities is

virtually inevitable under the circumstance. Management must rely on the ability of the staff putting trust in them to accomplish the task. In turn, the staff must use their knowledge and abilities to work in harmony putting trust in each other to achieve the innovational approach required.

Incongruities

Collins dictionary defines incongruous as "*inappropriate or out of place*". However, Drucker (2002) in his description takes the definition a little further by encompassing such things as necessary operations or procedures performed as part of a production process disliked by the people performing the operation. One such within Draeger Safety UK concerns a piece of equipment used in the production of lung demand valves. The particular piece of equipment used to test the functioning of the valve while some years old is nevertheless extremely reliable. This type of equipment is also used by certification test house (such as Lloyds and TUV) in conformance test of equipment. Thus, saleable products undergo tests on equipment similar to that used to gain certification. While not difficult to use the equipment required several changes of supplied air pressure, air flow rates and respiration cycles per minute during the test. These changes being made by manual adjustment of valves, proving both tiring time consuming and a possible risk of strain to operators. The industrial engineering manager tasked an engineer to as far as possible automate these valve actions. This being completed some months ago with the use of electronic switching and programmable logic controls. To carry on this automation and incorporate computer control. A project team was formed recently and is exploring the possibility of working with local universities to design and develop a replacement breathing test facility that not only carries out the function of existing equipment but incorporates possible future requirements.
While still in the very early stages this project has the possibility of removing the incongruity completely, incorporating data base technology and simplifying data analysis.

Process Needs

The operations department has the responsibility of manufacture and therefore process need plays a major part in driving innovational change.
The example given above of the seal insertion device is a response to process need and requires no further discussion.
Another prime example of process need driving innovation is the development of a new generation of pneumatic test equipment. The realization of this particular need arose from a growing opinion that the existing test equipment developed some five years ago and state of the art at that time. Could today be improved via technologies not used in the original equipment. This opinion eventually being held by production management engineers and staff operating the equipment. Therefore, the decisions to invest time labour and finance in the development of new test equipment came almost by default. As normal within Draeger Safety UK, an action team established to undertake the development consisted of cross-functional abilities with members tasked to work together maximizing joint ability's to achieve the set objective. However it soon became apparent that while the general technical, abilities where present within the company collaboration with external organizations would be required for the specific detail of some technical aspects. Thus, the team sought assistance from suppliers to specify particular equipment best suited to the needs of the system. Working in collaboration with suppliers of such items as laminar flow equipment, computer digital and analogue signal boards with signal conditioning a detailed, specification of the test equipment resulted. The possibility of commissioning a software supplier to develop software to control the equipment after investigation lead to a decision to develop software internally. Total control of software intellectual property

being the prime reason. Internal development also had the advantages of cost. The completed software being designed and programmed by engineers that knew and worked on the package as a whole not just the software. This allowed a system thinking holistic approach Senge (1990) instead of a reductionist approach taken by a company interested in software only. Thus the action team working with test operators suppliers and contractors specified developed and built the next generation of test equipment. An innovational approach bringing together hardware and software in ways new to the organization, providing direct reading of data by computer thereby minimizing risk of data entry error. The system also allowing subsequent data analysis of stored data thus providing information to direct future improvement.

Industry and Market Changes

Markets are customers driven and Draeger Safety UK responds to customer requirements through continuos product development.
Innovational drive in this area is by a combination of customer requests and internal development and enhancement. The latest developments to Draeger breathing equipment is the move to electronics from the traditional mechanical and pneumatic systems for air warning and pressure indication
These innovations arrived at through cooperation between the development department and suppliers of electronic equipment designing and developing new equipment to suit the applications and environments required.

Demographic changes,

Market demographics have changed for not only Draeger Safety UK but also all organizations. The changes to the political scene in China opening markets that were none existent only a few years ago. In answer to these changes, breathing apparatus specifically designed by Draeger Safety UK to meet the requirements of the market is assembled in a recently established plant in China. Thereby using local market knowledge and contacts to expand sales at a higher rate than would be possible if bases within the UK or Europe were used to service the Chinese market.

Changes in Perception

Example already given can also come under the heading of changes in perception. The development of the seal pack from the perception that quality improvement would result. Development of new pneumatic test equipment from a growing realization that new technology existed that could improve this function. Breathing test equipment development from the change in perception towards automation and computer control instead of manual operation of valves and hand written records of test data can also come into the changing perception category.

New knowledge,

"*Application of new idea or principles based on totally new knowledge, these have long lead times but can be the history making innovations*" (Drucker, 2002).
The examples of the seal pack and pneumatics test equipment are both of application of new knowledge. While not exactly in the history making division, for Draeger Safety UK such applications have supplied the innovational improvements allowing year on year achievement of improved overall results. Application of new knowledge is taking place on a daily basis within the organization ranging from knowledge gained from customer's

opinions incorporated into products, to knowledge of new production techniques. Therefore, the knowledge gained by individuals from whatever quarter and used in continuing improvements is the innovational lifeblood of the company. 0

Innovation in Terms of the Viable Systems Model

The Viable System and Innovation

Organizations can be viewed as viable systems; such viable systems have the objective of survival, the requirement to carry on into the future (Beer, 2000). Therefore if innovation is essential to continued survival as argued by writers such as(Drucker, 2000), (Senge, 1990), (Wheatley, 2001), (Eppinger, 2001) it must form part of the viable system. The model has five sub systems one of which (system four) deals with the "outside and then" "Outside" being described as the problematic external environment and "then" referring to the future. Thus, system four deals with innovation when formulating new processes, markets, products etc. In short, innovation is the responsibility of system four within the viable system model. Thus as all viable systems must by definition have a system four innovation is possible within all viable systems.

The Recursion effect on innovation

Viable systems are also considered to be recursive, the recursive systems theory states "*In a recursive organizational structurally, any viable system contains and is contained in, a viable system*" (Beer 2000, p.118). Viable systems can be envisaged as an infinite set of Chinese boxes or Russian dolls each containing and being contained within another viable systems at higher and lower levels of recursion. These levels of recursion extend from the "macrocosmic to the microcosmic" (Beer, 2000, p.312). In an organizational context, recursive viable systems are considered as the various organizational levels from holding company through divisions to plants then departments on to departmental sections then to individual personnel. Each of these levels forms a recursive organizational viable system contained in the former and containing the latter. Therefore, if each recursion by definition must contain a system four then innovation is possible at any recursive level.
Figure 2 shows a partial view of the levels of recursion for Draeger safety in the Chinese box format. The recursive levels shown in Figure 2 are only one of many possibilities. For example at the Draeger Safety Level, Draeger Medical or Gas Detection exists with recursions applicable to those divisions.
When viewed as a viable system it becomes obvious that the focus of innovation will have a close relationship with the functions carried out by the system. Therefore, the level of recursion heavily effects the focus of innovational activity. It is also possible for strategy to pass down from level to level driving innovation in the desired direction at each level. This trickle down effect is possible via a command channel running between each recursive level. It is via the command channel that one level influences and directs the general direction of the system occupying the level below. In the case of strategy the command channels between systems maintains the common general focus of all levels. The trickle down effect proved a driving force for improvement and cost reduction within the operations department of Draeger Safety, as outlined in section 4.3

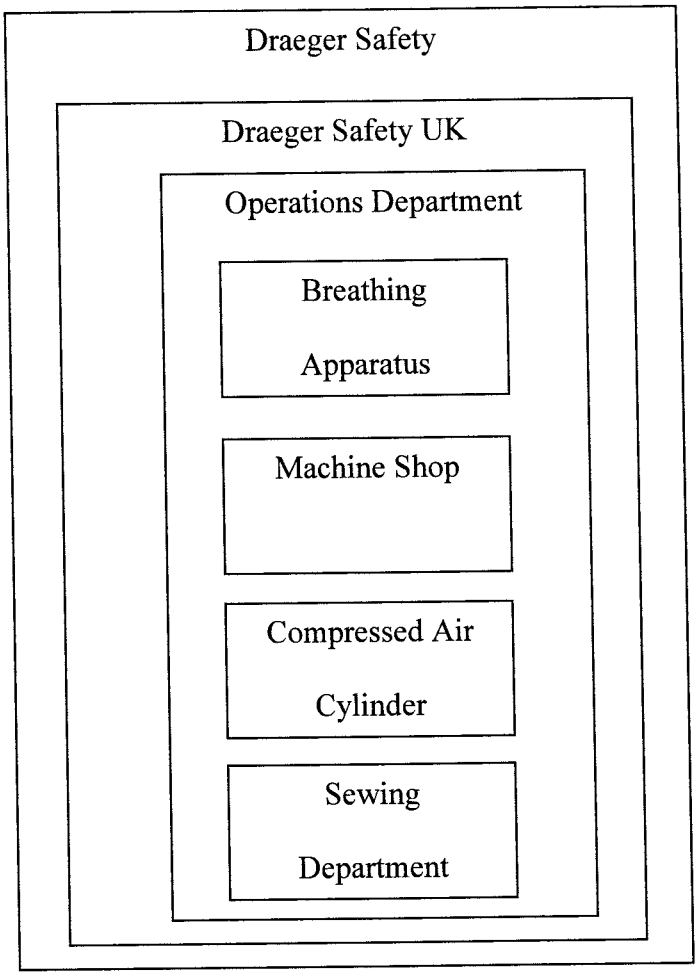

Figure 2
Levels of Recursion for Draeger Safety UK

Viable Systems and Innovation at Work.

In 1999, the board of Draeger (Parent Company of Draeger Safety UK) decided as part of corporate strategy to reduce the cost of poor quality by 50%. This became a directive and trickled down via the command channel from one level to the next. At each level while the goal was the same the innovation method used varied according to the function of the recursive level. Upon reaching the Operations department of Draeger safety, it was decided that an action group would be given the task of formulating methods and procedures to meet the directive. It is not the intention to detail the thinking and academic principles used by the group. A paper by Brown & Sice entitled "A Knowledge Management Approach to Reducing the Cost of Poor Quality-the Draeger Safety UK Ltd. Case" and presented at the UK Academy for Information Systems (UKAIS) conference 2003, detailed these methods and theories.
In short, it was decided to produce an IT system to collect data on items reworked and rejected. System output information being used to identify components and operations having high rework or reject costs. Once identified kaizen or action groups being formed to concentrate on improvements that would result in a reduction of poor quality cost. To enable production and operation of the IT system required the assistance and cooperation of assembly staff. Information on problems encountered and the time taken to rectify those problems being best obtained from the people actually dealing on a daily basis with

rework. The principles of trust in each other that data given and collected was accurate and used only for constructive problem identification and resolution became an essential part of the successful operation of the Cost of Poor Quality (COPQ) program. Such trust and cooperation being essential in today's workplace if innovation is to play a part Wheatley (2001).

Using the IT system to identify high cost areas and teams to investigate and implement improvements resulted by the end of 2001 in a reduction of the cost of poor quality from 3.5% to 0.5% of manufacturing costs. The success of this approach can be attributed to the people at the operational level taking ownership of the IT system, examining the outputs and deciding on relevant actions. It was people that provided the solutions, people that implemented them and people that provided the innovation. The IT system providing a channel to gather data and convert that data to useful information in a form relevant to the people at the operational level of recursion. Thus in the case of COPQ an innovational method was devised, implemented and operated by the people at that level to answer a directive carried down the command channel from a higher level.

A final point exemplified by COPQ is that of data and information. As the people who would eventually operate the system were closely involved in development, the language and terminology used for data and information was the language of the production not the technical or IT department. Thus, this deliberate use of the production language while possibly not technically accurate had two beneficial effects. The first is the reduction of transaction ambiguities. Beer (2000) maintains in the 'third principle of organization' that whenever information transmitted on any channel crossing a boundary undergoes transaction. Such a boundary exists between data collection and information production in the form of the IT system. When the language of the IT system differs from the language of the users, interpretation can introduce ambiguities and translation of meaning. Resulting in misinterpretation of data collected and information then supplied. Tailoring the language of the system to the language of the user reduces this possibility. The second advantage is empowerment through involvement. Users immediately became owners after all, they had a role in the look and feel of the system, they decided how and what data was to be collected, it was the users that decided the format of output information. Therefore, the involvement and empowerment of the people that actually use the system played a substantial role in the success obtained.

Conclusion

That Draeger Safety UK believes that its people are the basis of innovation and future success is without doubt. The development of the operations training department, staff development via training and education coupled with involvement and empowerment all point in this direction. However, the all-important question is has this approach delivered innovation as defined in the introduction leading to organizational benefits? To answer this question results will be examined from two distinct views, the hard issues of figures and the soft issues of opinion.

Factual examples of hard issues show improvements in all directions. Within production, for example the lung demand assembly area some two years ago produced an average of between 200 and 210 units per day, while the present average is 300 to 330 units per day. A 50% increase in production with the same number of people. Sales and profit targets have increased and been achieved for the past several years. Profitability measures such as profit per employee, return on investment etc. are amongst the highest within the Draeger group. In addition, investment for the future is increasing with additional building to enable expansion under way. The staff of Draeger Safety has embraced the idea of vocational training and education, with 191 people achieving nationally recognized NVQ, management and other courses up to higher degree level in the last three years. With a total

workforce of 356 this equates to 54% of the workforce engaged in educational improvement activities.
For the soft issues of opinion and perception, the following comments, and extract from written documents are indications of the beliefs and opinions prevalent within the staff of Draeger Safety UK and outside bodies associated with the company.
During a series of informal interviews on quality perception and inquiry, it emerged that the general opinion was in favour of the approach adopted. The people based approach had gained favour with the majority of staff, who felt that it had improved the quality of working life. Specific comments included

"I like working here, I feel respected as a person, things like that"
"This is a much better place than it was ten years ago"
"It is a far more relaxed atmosphere in the machine shop now and we are still getting the work done"
"I find people here are particularly happy, contented you know willing to talk to you"
"I like working with other people, I like being in control and achieving what I set out to do"

An NVQ examiner writing to a Draeger Safety UK training officers states:
"Your organization sees the ongoing training and development of staff as a key aspect of success in the marketplace"

While a member of staff, in an email to a course tutor writes:
"I have now realized that most folk who 'care' are passionate about their role in the work environment and desire to do well for their boss and the company"

The small selections of both hard and soft issues given above nevertheless are indicators of the success of the improvement through innovation via staff knowledge and involvement taken by Draeger Safety UK.
The answer to the question "has this approach delivered innovation as defined in the introduction leading to organizational benefits", is a resounding yes. However as innovation by definition is a never ending quest, then the aim of improvement through innovation is likewise never ending. As an organization Draeger Safety UK will not sit back and think we have done it we are there. For the simple reason, there is always another improvement awaiting discovery. Draeger Safety UK has chosen to put faith in its people via empowerment invest in staff development and make innovation and continuos improvement in all aspects of its business a cornerstone of it philosophy. For this organization, it has paid dividends financially and culturally; putting Draeger Safety UK well placed in today's rapidly changing market environment that requires innovational adaptation to survive and continue as an organizational viable system.

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Towards a Participative 'Second – Order' Research Design. Consultancy and Research Experiences at Draeger Safety UK

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Abstract

This paper presents an approach to research design based on theoretical perspectives from systems thinking and complexity science, and reflections on practice in research and consultancy at Draeger Safety UK. The underlying assumptions are grounded in interpretation of insights from autopoiesis, non-linear dynamics and studies of the role of language in dialogue. It is argued that a participative 'second' order research design is needed to bring into consideration the importance of language in creating reality and to engage organisational actors as researchers in evolving the learning capability of organisations.

Background

Draeger Safety UK is based in Blyth, Northumberland. It manufactures breathing apparatus for the search and rescue services and is a market leader in the UK and a major international player.

Because of the need to remain competitive and because of their reputation for quality, communication and knowledge sharing is recognised as being an important issue within Draeger. Despite this, and although over the years the company has introduced a variety of communication practices, knowledge sharing continues to be raised as an issue for improvement within various employee surveys. The most likely cause for this dissatisfaction is that the various knowledge sharing practices have been introduced, without general consultation with the workforce and in a somewhat ad-hoc manner. It was this experience that led Draeger management to enter into a joint research programme with Northumbria University to explore and suggest improvements to Draeger Safety communication and knowledge sharing practices.

The programme set out to answer two questions:

1. How do we conduct the process of enquiry in a systemic way?
2. What is the systemic framework of reference used in analysis and recommendations for improvement?

This paper outlines the process of enquiry and its underlying assumptions. It is based on theoretical perspectives from systems theory and complexity science, and reflections on practice in research and consultancy work at Draeger Safety UK.

Underlying Assumptions

Both authors have a research background in systems thinking and managing of complexity. Thus, their perspective is inevitably influenced by the insights of the systems methodologies, as well as autopoiesis, chaos theory and complexity. Such a perspective promotes opportunity, but at the same time implies an inevitable blindness. Thus, in order to recognise and give form to this blindness, it is important to clarify (briefly) the

underlying assumptions upon which their view of knowing and acting in a situation are based.

Avoiding fragmentation

The most basic cognitive operation we perform as observers is the operation of distinction. It is through the operation of distinction that we specify a unity as an entity distinct from its background (Maturana and Varela 1987). We characterise both the unity and the background with the properties with which the distinction endows them and specify their separability. If the observer applies the operation of distinction recursively and, thus, distinguishes the components within the unity, he redefines it as a 'composite unity', i.e. a system. It is through our human way of being that we perceive the world in terms of systems. The autopoietic epistemological perspective suggests that cognition (the distinctions we make) is conditional to embodiment. The act of cognition is a matter of interacting with the world, in the capacity in which one is able to interact, and not simply the act of processing what is objectively to be 'seen'. Thus, systems are epistemological qualities and not definitions of how things actually are or occur. The problem is that our thought is pervaded with differences and distinctions and this leads us to look on these as real divisions, so that the world is seen and experienced as actually being broken up into fragments (Bohm 2000). This 'fragmentation', however, does not have an absolutely objective existence since our distinctions are epistemological qualities, not 'true' realities.

Different observers make different distinctions and thus perceive and describe systems, and therefore, their boundary and their structure differently. The observer has to be accounted for as part of any explanation. Nevertheless, systems have become the means by which we explore and describe the consistency of situational behaviour. Therefore, descriptions of system structures are useful tools and, if some form of agreement can be reached with regard to 'what a system does' then it is possible to communicate about its structure and boundaries with greater (in relative terms) coherence. Therefore language needs to take account of a systemic vocabulary.

The evolving-order

When making sense of a situation we look to identify the things that matter and the relationships between them, i.e. the system and its structure, which we describe as the order of things. At any given stage it is possible to describe a certain order as relevant and appropriate. The problem, however, is that in practice we often act as if the order that we perceive is a given or absolute reality. Very often social groups and societies work with categories of distinction upon which they implicitly agree, and because these categories are valid for the majority, they are accepted as if they have some sort of objective existence. This is dangerous because when the context of enquiry changes and new perceptions of order are needed, the mind tends to cling to these old perceptions since these are what have been accepted. Such implicit conventions of order, when held fixed, stifle creativity. Moreover, they can lead to a breakdown in communication between the supporters of the new emerging perceptions of order and the stabilised or well-accepted perceptions of order. This, of course, is because we tend to reinforce our concepts and beliefs as though they are absolute and in so doing we choose to fragment 'the world' from ourselves, without recognising that we are participants in its creation.

What we need to remember is that our concepts and their meanings are moulded by the activities of our everyday life within our social group or society. When the context of this society changes new categories are needed. Thus, working with the old set of concepts within the new context will more often than not result in inappropriate behaviour. In essence, our ordering of 'reality' influences how we live and our life together gives

meaning to our concepts. It becomes clear, therefore, that we should adopt fluid rather than fixed perceptions of order. This implies that the definition of a system is a dynamical activity. It involves both objective and subjective reality and the cycle of perception and action, that unites them. Indeed, the definition of the system is likely to change in a whole host of ways when new distinctions are identified and become relevant. Thus, any attempt to freeze the definition of any system stifles creativity. It constrains knowing by forcing new explanations to be built on frozen categories, as though these were absolute truths given in nature rather than specified by us. Systemic language should continuously evolve and reinvent itself. This implies that order is also dynamic and that our perceptions of order change in the continuous cycle of interaction between the subject and the object of knowing.

Our Western culture embraces the perception of static order. Consequently, we implicitly believe that we can find an order that explains behaviour; or that we can conjure and implement an order that generate the behaviour that we want to achieve. It is the assumed position that the World is governed by orders that we call laws. And, if we discover these laws we can explain, manage, control and even create systems to obey them: God has created the Universe according to his order, thus, it is the job of the managers to create and govern organisations according to their understanding of order. Authors such as Nicolis and Prigogine, however, consider such a premise to be a misconception. They contend that man must have looked for the power of creation in the wrong place and, because of this, created the domination of one person's will over the others; and an order of human enterprise where control and rigid structures are the norm. The power of creation, as studies in deterministic chaos have shown, lies within what is being created, within the building blocks and their communication with each other. There is no one to build nature, thus we must give to its very elements - the microscopic activity, a description that accounts for the building process (Nicolis and Prigogine 1989). Moreover, in the case of human enterprises these elements (and the description of the building process) lie in the people (no matter what their seniority) that inhabit them (Prigogine and Stangers 1984).

Developing awareness

Whilst doing and reflecting are inseparable from the process of knowing, we should realise that there is another form of action that (although often unappreciated within Western culture) is equally important to knowing the World: The action of examining personal experience, or as Varela puts it 'the act of becoming aware' (Depraz, Varela and Vermersch 2003). While Eastern traditions such as Buddhism have developed the act of 'becoming aware' as part of their meditative practices, within western culture, exploring personal experience has been neglected as an action fundamental to knowing. Our experience of the world is born in our interactions with the environment and these are validated by our embodiment. These, experiences represent irreducible first-person ontology (Searle 1993). Thus, we cannot explain experience 'on the cheap', by assuming a third person or objective viewpoint. What is required is to recognise that both first-person and third person accounts, and their interplay, are necessary in order to do justice to the quality of our knowing. This is where many philosophical investigations of experience have had difficulty, since in general they deal with the issue of exploring human experience as one of pure reflection (Chalmers 1993, Heidegger 1958). Enactive cognitive science points to an alternative: what is needed, is a disciplined act of cultivating our capacity 'of becoming aware' of the sources of our experience and, thus, opening up new possibilities in our habitual mind stream.

In Varela's (2003) work, this action of becoming aware is punctuated by three 'gestures':

(1) Suspension – a conscious transient suspension of beliefs about the thing being examined;
(2) Redirection – turning ones own attention from the object to its source, backwards towards the arising of the thoughts themselves; and,
(3) Letting go - changing ones attitude from looking for something to letting it come.

To be successful organisations should be looking to develop the quality of awareness (often a new capacity) of their members, because the cultivation of the capacity 'of becoming aware' is the basis for human creativity and success: As the Japanese philosopher Kitaro Nishida (1990) puts it, 'the burst of insight is a quality of experience sustained in one's spiritual practice'.

Language: Communication and Co-creation

In the previous section we have argued that the cultivation of awareness is an important aspect in the enhancement of the quality of our knowing. To end there, however, would limit our understanding of the scope of this knowledge to a one of private ascertainment. To be of greater benefit this gain in our awareness must be expressed explicitly in language, to form communicable items. Moreover, it is clear that once these descriptions are made public they become part of the environment and, thus, shape our experiences as much as the gain in awareness that shaped them (Sice and French 2004). Thus, again, it becomes clear that the mind and the world that we bring forth through our languaging together are not separate, but exist in continuous co-determination. It is this reciprocal relationship, between experience and language, that organisations need greater cognisance if they wish to promote creativity and innovation. From the autopoietic perspective, language is not a tool to reveal an objective world; rather language is a venue for action, coupling the cognitive domains of two or more agents. It is through languaging that we coordinate our actions and create our world. Because of this, we have a responsibility to create communication practices that will allow, at least transiently, the coexistence of different understandings as we develop and explore our language together. Bohm (1998) suggests that a new type of dialogue is needed in human communications. The basic idea of Bohm's dialogue is to be able to talk while suspending your opinions, holding them in front of you, while neither suppressing them nor insisting upon them, not trying to convince but simply to understand, without having to make any decisions or saying who's right who's wrong.

This view is also supported by the theory of autopoiesis. Maturana and Varela (1980) suggest that it is the dynamics of the structural coupling of the interacting organisms that determines the interactions, although it might seem to the observer that it is the meaning (of a word) that determines them. Thus, it is not agreeing on a particular meaning that is operationally valid in communication but rather engaging in and expanding the interactions between the communicating entities. The form of dialogue suggested by Bohm encourages opening up and engaging ourselves in listening without a particular purpose, listening for the purpose of hearing what is it that is being said, whilst trying to consciously suspend our assumptions and judgements. This type of interaction we shall call meditative listening. It is building awareness of what there is to be heard without focusing it through the lenses of our judgements and assumptions. This implies that we are perfectly aware that our opinions and judgements presuppose our world and our understanding and it is the way we as humans make meaning of this world. However, opening up as an action of developing awareness, listening without a particular purpose of solving a problem or defending an opinion, this meditative listening increases our chances of becoming sensitive and, thus, able to hear the prejudices of actors outside of ourselves. That will create a new frame of mind in which there is a common consciousness (Bohm and Peat 2000).

The Process of Enquiry. Towards a Participative 'Second-Order' Research Design.

As we are restricted by the sequential nature of the narrative, we have chosen to first describe the process of enquiry and then present our reflections on practice, although in real life the design of the process of enquiry is based on insight from theory and practice and has been continually revised and amended.

The process outlined is iterative. It is a closed cycle of exploring, reflecting and developing language in dialogue. Thus, it is conceived as a 'second order' research design. By which we mean that the process of enquiry involves understanding, not only of ones own perceptions of a situation (first order understanding), but also, understanding of others' worldviews, second order understanding (analogous to Heinz von Foersters (1979) second order cybernetics). In the proposed process employees participate as researchers in their own right. It is not action research conducted by a third party, but research conducted by employees with input from a third party. This participative 'second-order' process of enquiry is shown in Figure 1.

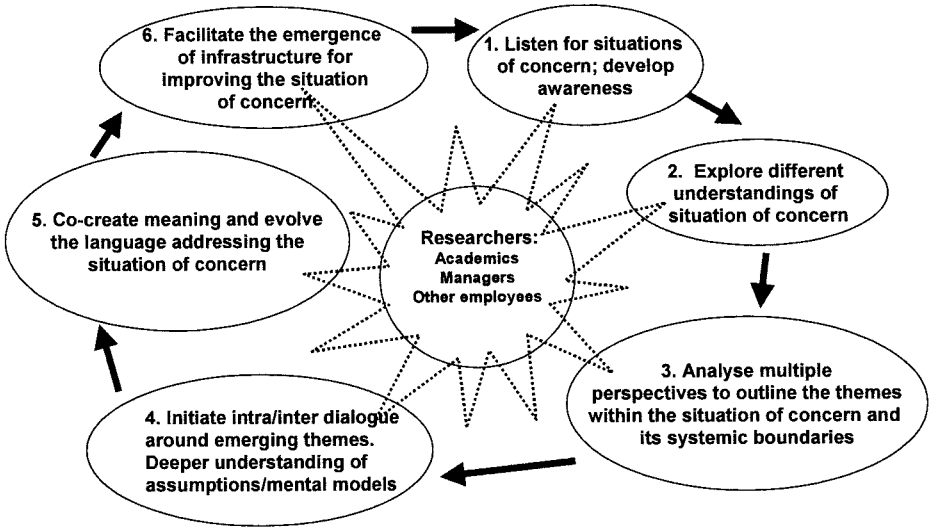

Figure 1. A Participative 'Second Order' Research Design

The individual stages 1-6 (Figure 1) are developed below:

1. Listen for situations of concern; develop awareness

Developing awareness must be recognised in its own right. This may include observing, experiencing and sensing as well as informal and formal communication practices (meetings, conversations, dialogue groups). This stage is important in the development of an understanding as to just what the situations (issues) of concern may be. As this understanding is taking shape, the researchers/consultants are listening for opportunities where the organisational actors may be willing to engage in further exploration of the situations of concern by forming volunteer research teams that may include employees, managers or external consultants. The choice of a team facilitator is important, as the team facilitator is responsible for creating the conditions for effective communication within the team and with other stakeholders.

2. Explore different understandings of situation of concern.

Several recognised research methods may be used in stage 2 - for example semi-structured interviews. Here, two researchers are more effective. One leads the interview with general questions whilst the other concentrates on peripheral matters, arising from the main questions. In this way, with few main topics, a richer picture can emerge allowing exploration and further analysis.

Dialogue groups with stakeholders are another approach; these sessions can be conducted by members of the project team or with the help of professional facilitation. Informal conversations and formal organisational meetings are also sources of research data. Intranet discussion forums allow individuals to partake in virtual discussion groups at time and place that suit themselves.

A mixture of the above methods suited to the situation and system can be employed to provide research material that is used to develop understanding of the situation of concern from multiple-perspectives.

3. Analyse multiple perspectives to outline the themes within the situation of concern and its systemic boundaries

The cross analysis of interviews by at least two researchers is used to identify emerging themes of concern and to identify the system boundaries as seen by the interviewees. Software tools may also be used to contribute to the language analysis, however such tools are seen as an assistance, rather than a necessity. However, whatever form of analysis is employed the outcomes should take the form of an agreement between the organisation members of the theme(s) of concern and the system boundaries.

4. Invite intra/inter dialogue around emerging themes. Deeper understanding of assumptions/mental models

Stage 4 may include systems thinking development workshops to share insight into systemic analysis and issues for dealing with complexity.

Reflective dialogue is also a useful method if utilised around assumptions and insights from Stage 3, since Stage 3 findings should represent a shared understanding and not individual feedback. It may be necessary to utilise professional facilitation within dialogue groups in order to develop the focus to explore underlying assumptions and the creation of shared meanings.

An important part of this stage is exploring and bringing into the open mental models, beliefs and assumptions. This is not an easy task but can be achieved with the use of influence diagrams (from systems dynamics), story telling, narratives, art and so on. Simulation models can be used as what-if micro worlds. The outcome from Section 4 is a deeper understanding of underlying assumptions and mental models.

5. Co-create meaning and evolve the language addressing the situation of concern

Stage 5 utilises dialogue sessions to bring to the surface issues that need addressing (issues that something needs to be done about) and developing insights into how to deal with these. The outcome is the development of a shared language to deal with the situation(s) of concern (Krippendorff, 1997).

6. Facilitate the emergence of infrastructure to improving the situation of concern

Stage 6 is about the development of infrastructure - implementation strategies and teams to deal with insights and recommendations from stage 5. An approach to team formation, with both vertical and horizontal team membership gives a departmental as well as an organisational wide (systemic) view to implementation.

Department A	Department B	Department C	Department D
Department Head	Department Head	Department Head	Department Head
Supervisors	Supervisors	Supervisors	Supervisors
Specialists	Specialists	Specialists	Specialists
Implementers	Implementers	Implementers	Implementers

Table 1. An approach to team formation, with both vertical and horizontal team membership

As can be seen from Table 1 teams have a vertical departmental based element. Vertically each team has members from all levels of the department championed by the departmental manager. Members of other departments can be utilised as consultants if and when appropriate. The horizontal teams consist of one member (at similar organisational level) for each department, etc. The horizontal element brings the cross-departmental communication and exchange of ideas and opinions allowing an organisation wide holistic view. This approach provides the means of developing teams to address the outcomes of stage 5 in a manner best suited to the organisation and situation(s) of concern.

The process of enquiry described in Figure 1 introduces a systemic approach to research design. It is embedded in the practices recommended in stages 1-6 (dialogue, exploring multiple perspectives, developing language, etc.). However, it is important to understand that this is not a prescription; the recommended practices can take different form and focus depending on the particular context and organisational circumstances. Stages 1-6 are distinctions made for clarity of description. In real life these overlap and do not necessarily follow in sequence.

Some Experiences at Draeger Safety UK

The experiences outlined below are by no means a complete reflection; rather they represent only partial glimpses of the work carried out at Draeger Safety UK. The project commenced in the spring of 2003.

Stages 1-2. To begin with semi-structured interviews, informal conversations and participation and observation at meetings, were used as vehicles for developing awareness of the situation. It was soon realised, however, that this was not resulting in what was expected. Interviews, questionnaires and sitting at meetings all helped understand people's attitudes, frustrations and difficulties, but the whole picture of how people talked together and made sense of communication and knowledge problems together was missing. Intuitively, it was realised that unless it were possible to engage people in talking together about their problems, there would be a lacking of understanding. Thus, in addition to formal and informal conversations a workshop was organised on communication and information, and knowledge sharing issues. This helped to engage people in conversing, reflecting and explicitly presenting their understanding. It also gave a sense of legitimacy to the research, as individuals began to believe that their concerns were actually being considered, and more importantly perhaps a feeling emerged that: 'we are here to treat each other well and to discuss how to develop our world in a way meaningful to us all'.

The work, however, was paid for by the Operations Department and thus (initially) we only had access to the employees of the Operations Department. This proved restrictive as it soon became apparent that communication and knowledge sharing could not be explored in isolation from the overall organisational landscape. Unfortunately, further resources were not available to broaden the scope of enquiry to cover the whole organisation using the Operations Department approach. We needed more people. To overcome this we introduced a couple of postgraduate students to work with the other departments, which were - customer services, R&D, and IT. Although the student involvement did not guarantee that we would get consistency and quality in conducting the enquiry, through the student projects we developed a network of managers/employees from the different parts that were keen to participate in the research process and they formed our 'voluntary' research team.

Stage 3. Several themes of concern with regard to communication and knowledge sharing began to emerge. These were: clarifying the 'meaning of' and 'conditions for' effective communication, formal and informal communication channels, and effective knowledge management. What was needed was to raise these themes for concern with senior management. Here it was realised that unless the language used to 'talking about' the emerging themes of concern was contained within the landscape of objectives defined by senior management, the project would die from lack of resources. Luck and intuition enabled the findings to be present to the Board under the theme of Effective Knowledge Management. Senior Management and the Managing Director decided to promote our work. The label had to be Knowledge management as the current management priorities recognised this as legitimate concern.

Stage 4. There had already been some success in engaging organisational actors in workshops to facilitate discussions with the view to generate common understanding. What was needed next was to engage the senior management team in understanding the assumptions and underlying mental models with regard to effective communication and knowledge management. A workshop was initiated by the managing Director, planned and prepared in consultation with the participants, organised by the authors and conducted by a professional facilitator. The constituency of the workshop and that it generated commitment and further action was important. As consultants we had the opportunity to introduce our voluntary team of researchers to participate in the workshop. The workshop resulted in distillation of four 'tipping' points (main topics of concern that would have a cascading effect within the organisation), and commitment to four action plans to address these points. This workshop secured the successful introduction of Stage 4, which is where we are at this moment of time.

Stages 5-6. The plans are to conduct a 3rd workshop to rethinking the action plans and developing an infrastructure for their implementation. Here an approach to team formation, with both vertical and horizontal team membership, will be important to create conditions for integrated organisational conversation. The role of our 'voluntary research team (6 managers from different departments of Draeger Safety) will be to facilitate horizontal communication between 'vertical teams'; to conduct systemic analyses and gradually contribute to developing the organisational language to include systemic concepts. Immediate plans include diagnosing and designing communication and knowledge requirements through a Viable System Model of Draeger Safety UK (Beer 1979). This is to serve as a focus for any improvements and recommendations and is being developed with the active involvement of the 'voluntary research team'.

Positive Implications of a Participative Second-order Research Design

Currently, more than 40 managers and employees have been directly involved in active conversation and the development of language for effective communication and knowledge sharing. However, the challenge is - How do we involve all 360 Draeger employees in this conversation? Or should we?

May be not all employees need to be, or will choose to be, involved in every organisational conversation. However, what is important is that a culture of conversing is developed, where employees can talk and decide together how they live and work together. This is where a Participative Second-Order research design can help.

In interpreting systems methodologies we are used to talking about the 'real world' and the 'systems thinking' world (Checkland 1981). Although such distinction may be helpful to distinguish between epistemological constructs and real world, it hides the fact that language and indeed systems language is part of our environment and, thus, part of the real world. May be we should consider developing systems concepts as part of the organisational language that is indeed part of the 'real' world. However, until we realise that the 'systems thinking world' forms part of our 'real' world we cannot use systems thinking effectively in 'real' organisational conversations as language is not an agreement in opinions but in form of life (Wittgenstein, 1967).

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A KNOWLEDGE MANAGEMENT APPROACH TO REDUCING THE COST OF POOR QUALITY-THE DRAEGER SAFETY UK LTD. CASE

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Abstract

In 2000 Draeger Safety UK Ltd., Blyth pioneered a knowledge management approach to reducing the cost of poor quality. The approach draws together principles from reductionism, holism and systems' thinking under the banner of quality improvement. This paper explores the philosophical perspective and the implementation of the approach within Draeger, which came to be known as the 'Cost Of Poor Quality' (COPQ) methodology.

Introducing COPQ in practice resulted in reduction of the costs associated with poor quality from 3.5 % to less than 0.5% of overall manufacturing costs. The additional wider quality benefits from enhanced communication, improved inter-group and personal relationships allied with a sense of individual and group empowerment proved to be even more valuable to the company than the cost reduction. The introduction of COPQ contributed to the development of a quality centred culture, not only in relation to produced saleable items, but also with regard to processes, employee' responsibilities and relationships.

Keywords: quality improvement, knowledge management, systems' thinking
Stream: Co-ordination
Topic: Knowledge Management

1 Introduction

Draeger Safety UK Ltd, is based in Blyth Northumberland, and is part of the Draeger group of companies who manufacture search and rescue breathing apparatus for a worldwide market. The products from Draeger Safety UK are used predominantly by the emergency services to sustain a clean air supply in none breathable atmospheres, and often in life threatening situations. Thus, their reliability in use must be beyond question. And consequently, manufacturing quality is of paramount importance.

In 2000, as part of the company's continuous improvement program, under the umbrella of the so called 'Draeger Best' initiative (A derivative of the European Foundation for Quality Management (EFQM) model) a breakthrough strategy was introduced, which required that the costs associated with poor quality be reduced by 50%. Thus, the Cost Of Poor Quality (COPQ) system was instigated. This eventually developed into the full-blown quality inquiry and improvement philosophy that will be discussed here.

In this paper, it is intended to describe the development and use of the COPQ philosophy within Draeger. Results will be presented, set against the context of the wider quality arena. Aspects of reductionism, holism, systems' thinking, complexity, and knowledge management, will be explored. All of which, will be encompassed within a total quality management framework. The interplay between these theories and their influence on the various systems' groups and individuals, being of interest in understanding the eventual beneficial effects gained from the COPQ philosophy.

2 Quality Standards

Quality standards, their definitions and their acceptance, are highly sensitive and, thus, problematic. The sensitivity stems primarily from perceived imbalances in market segmentation, due in part to mismatches in the standards required by different countries and organisations. Governments and Industrial Governing Bodies issue standards, directives and guidelines, each with differing requirements. Standards that are accepted within one market area or country are unacceptable in others. Such a plethora of standards, directives, and guidelines tends to generate a pragmatic approach to quality, in which different quality measures are adopted depending on circumstance. This, however, can lead to complexities in the design or manufacturing processes that can prove to be restraints to quality improvement.

External Quality Definitions

Such standards may be viewed as industry wide norms and criteria forming a framework for quality, conformance to these requirements being a minimum requirement for acceptable quality products. External standards emanating from governmental departments both national and European Union, can be required by law or issued as guidelines. Other institutions classed as notification and accreditation bodies (Lloyds and TUV being primary for Europe) ensure governmental standards are adhered to and maintained.

Such bodies and standards must be considered a part of the macro environment that Draeger operates within. The company can bring little influence on additions or changes to these standards and regulations. From a complexity viewpoint (Beer 1990), such a

situation adds unknown variety. New standards, alterations or additions to existing standards can render practices obsolete or requiring reform to maintain compliance.

Internal Quality Definitions

For Draeger internal standards come in the form of Draeger Manufacturing Norms (DMN). Such internal standards operate within the microenvironment of an organisation. Thus, organisational influence and control can be exercised with regard to such standards. It is such control of standards, working practices and procedures that define the company's shape, and to some extent the organisational culture. Management uses such operational norms to reduce complexity via definition of responses to various situations (Beer, 1990), formulating actions and procedures to cover envisaged situations. However, if internal standards become restrictive, straight jacketing individuals, stifling both the individual and organisational ability to react quickly to changing or unforeseen circumstances, then such standards can become detrimental to overall performance. Complexity reduction through internal standardisation taken to extreme, causes organisational inability to react to changing customer requirements, and other situational changes leading to reduced operational effectiveness, lost orders and revenue decline.

Internal standards can also be described as the official cultural face of an organisation shown to customers, and suppliers. Nevertheless culture has unwritten rules often carrying greater influence on quality, actions and relationships within organisations than published standards and norms. In the face of such deep-rooted implicit rules published standards can and often are ignored rendering them ineffective and of little use. This organisationally private, underlying, unwritten, unofficial, in some cases so ingrained within organisations as to be unconsciously adhered to, set of rules and norms can have profound effects on quality achievement and the organisations ability for adaptation, innovation and improvement.

3 Quality Inquiry

The combination of external and internal standards can be viewed as the organisational quality framework. However, having such a framework is no guarantee that high quality products will result. While the framework forms the foundation for building a sustainable quality culture and environment capable of innovation, adaptation and continuous improvement, the quality inquiry is the process which makes this possible.

The traditional view of quality inquiry is to devise a set of metrics used to ask three questions.

- Are set standards being achieved?
- Are standards being achieved consistently?
- Are standards being achieved at a cost and time capable of providing competitive cost and delivery criteria?

For many organisations, this is all that matters in quality inquiry and no deeper consideration is given. However, for effective quality inquiry leading to continuous improvement a deeper more detailed view must be taken. Operational process and procedures can in themselves influence output or delivered quality. Poorly designed, poorly functioning processes, inadequately or improperly trained staff, people unsuited to supervisory positions can cause quality inadequacies and poor performance. Attitudes and mindsets play a critical role in the formation of the systematic opinion to maintenance and improvement of not only quality products but also the continuous improvement of process,

people, relationships and communication at all levels. This is the truly complex world of quality inquiry where standards are considered important but the people and procedures responsible for the delivery of those standards considered more important. Culture shapes organisational attitudes and beliefs influencing the wholeness of the quality perspective. Culture and quality fold back on themselves organising behaviour, reinforcing the perception of quality and at the same time causing its evolution.

Culture shapes attitudes, attitudes shape quality. A holistic quality culture is one in which interpersonal, interdepartmental and interfunctional working relationships and communication are allowed, and encouraged to flourish. A culture that uses internal standards to give guidance and direction rather than imposes regimentation and strict adherence to rules, will maximise the benefits and advantages to be gained from full quality inquiry, encompassing its true entirety and complexity. Such an embrace of the wholeness of quality will allow enterprises inhabited by autonomous beings, i.e. people, to utilise the chaotic order naturally present in human systems and use it to drive evolution through individual initiative. Quality inquiry in the holistic system wide sense then becomes the driving force for continuous improvement, empowering personal as well as organisational adaptation and learning.

4 COPQ Philosophical Overview

COPQ originated in the form of a cost reduction project, the stated aim being to reduce costs associated with poor quality by 50%. This seemingly simple statement, however, leads almost inevitably to a philosophical debate on quality and quality costs. A return to the definition of quality and thus by implication poor quality becomes necessary. Not to mention what costs are to be associated with poor quality or the boundaries to be used in calculation of such costs. Pragmatically, such boundaries and definitions must be established for constructive progress. A pure holistic view might argue that true costs of poor quality are incalculable. How can you calculate how loss of reputation affects future orders? Such factors are qualitative, thus, difficult to accurately measure and give quantitative values. In opposition to this, pure reductionism holds that all possibilities are quantifiable when reduced to an appropriate level of simplicity. Thus, costs can be quantified, given values, and therefore computed to give a figure. Getting the right balance between holistic and reductionist perspectives will depend on the boundary established for the quality investigation. As the extent of the boundary grows so complexity increases, unfortunately this increase is exponential, thus widening system boundaries has profound effects (Beer, 1990), increasing uncertainty and variability within the system.

Complexity and variability further increases as situations and reactions outside the immediate control of system managers are encompassed within the boundary. This situation can only reduce the manager's ability to control the system. The COPQ development required establishment of boundaries and definitions that limited variability to proportions capable of being handled as part of routine operations at shop floor supervisory level and capable of direct alteration by Draeger operational personnel. Primarily for the above reasons poor quality costs were defined for COPQ purposes as:

- The purchase, manufacturing or assembly cost of any component or assembly found not to conform to the relevant standard and incapable of rework.
- The cost of rework required in rectification of components or assemblies to maintain compliance with the relevant standards.

Boundaries being set to operations carried out within individual assembly and other identifiably separate work areas. In this way, complexity was reduced to manageable

proportions while maintaining operational control and providing meaningful poor quality costs. Thereby allowing the application of knowledge management theory and practice (Davenport & Prusak, 2000) to affect quality improvement and cost reduction.

Development and Operation of COPQ

For some years Draeger had actively pursued a continuous improvement policy, which was based upon a Demming Wheel, or Plan, Do, Check, Act (PDCA) cycle (Slack et al, 1998). The PDCA cycle employs a circular, system thinking, methodology, also, there is a hint at the learning that may be attained from use of such an approach through the actions emerging from the Acts phase. Moreover, both this circular dimension and learning principle are vital elements of the COPQ philosophy and must be maintained within any model used to represent the underlying principles of COPQ. Unfortunately, however, the PDCA approach was not able to fully satisfy the knowledge management requirements of COPQ, since the definitions of the four actions do not clearly define the transformation of data to information, or information into knowledge. The PDCA model shown in Fig. 1., clearly illustrates this shortfall.

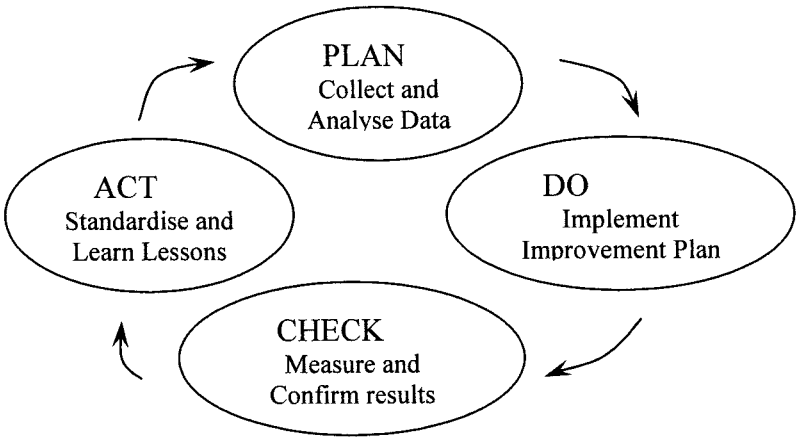

Fig. 1. The PDCA Model
Source Slack et al (1998)

Within the literature, several knowledge management models are available. Of these, the generic Data, Information, Knowledge, Action, Results (DIKAR) model, Fig. 2., was found to most closely align itself with the phases and transformations required by the COPQ philosophy. But, as can be seen in the representation of the model presented (taken from Murray (2000)), the DIKAR model is normally shown in a linear form. This linear form contradicts our requirements for a systems' thinking approach, since as argued by Senge (1999), systems' thinking is based on a philosophy of circular thinking.

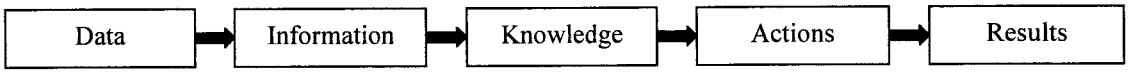

Fig. 2. The DIKAR Model
Source Murray (2000)

Therefore, despite the fact that the DIKAR model clearly shows the phases and transformations required by COPQ, the linear nature of its traditional representation, exclude it from direct use.

The aspirations of the COPQ philosophy required a methodology that embodied both the clarity of phases and transformations of the DIKAR model and, at the same time, the circular nature of the PDCA model. To satisfy these requirements, a hybrid methodology was devised from an amalgamation of these two models. The resulting amalgamation of these two models is shown in Fig. 3., and illustrates the true nature of COPQ, as a knowledge management and continuous improvement philosophy.

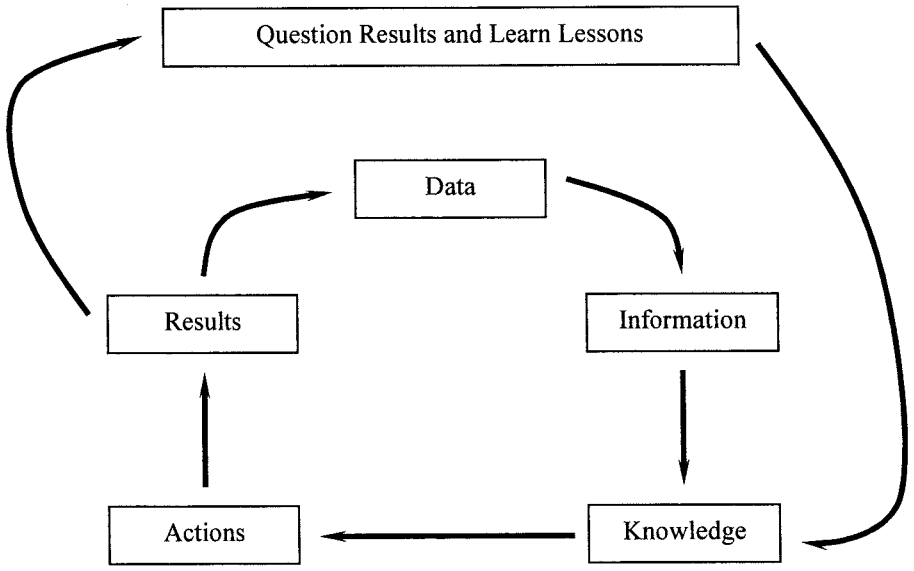

Fig. 3. The COPQ Philosophy Model
Data, Information, Knowledge, Action, Results, Question and Learn (DIKARQL)
A combination of the DIKAR and PDCA models

This amalgamated model closely matches the requirements of COPQ and mirrors the aims that underpin its philosophy. Boxes represent the phases and can be considered as static repositories, whilst the arrows represent dynamic transformations between phases, turning, for example, information into knowledge. The transformations are important, as it is the actions in the transformations that drive the system, thus, producing results and allowing learning and improvements to take place. Moreover, with each completed iteration the knowledge base increases and this knowledge may be fed back into subsequent iterations. The model shows the normally linear DIKAR, formed into a (circular) continuous cycle. The primary IT contribution to COPQ lies in the data and information phases. The knowledge, action and results phases are the people centred heart of the COPQ philosophy. Thus, whilst IT is used to collect data and provide information, it is recognised that it is the people who 'produce' knowledge from this information and formulate the knowledge based actions that generate subsequent results. The inner loop can be considered as an example of single loop learning. However, to obtain the maximum benefit some form of double loop learning is required. To achieve this, an outer loop is introduced which links results to knowledge, via a phase in which the results are examined, in the search for new lessons that may be learnt from the experiences of implementation of knowledge actions.

Thus, this loop drawn from the act phase of the PDCA cycle completes the overall model and generates the circular thinking continuous improvement, double loop learning model required to fully gain best advantage from the COPQ philosophy.

The model as developed is not only suited to the philosophy of COPQ but encourages circular systems' thinking and can be used as a generic quality inquiry tool. This model is capable of use in all quality inquiry situations regardless of the nature of the inquiry, be it into the quality of products and services, operational effectiveness, or the people quality aspects of any operational environment. Using this model the final goal or target will dictate the nature and content of the data collected, the method and contexts utilised to transform that data into information and finally the methods adopted to generate knowledge and knowledge actions to utilise the information to the full. The model also is a clear indication that quality enquiry is a never-ending ongoing activity that in its fullest sense should be used to add knowledge to an organisation. Thus, improving effectiveness, increasing the knowledge base and, encouraging people and groups to question situations, asking can this result be accomplished in a more productive cost-effective manner. In this way the full value and benefit from quality inquiry will be obtained.

Having established the general knowledge management approach to be used, the COPQ team had to decide a suitable data structure for the IT system to be developed. The following criteria were used to develop the structure:

- The structure must model the actual events within the assembly areas.
- The data collected and stored must be the minimum required to fulfil the objective.
- Data was to be collected at point of origin (assembly operation).
- Data was to be input to the system by assembly operation personnel.
- Data input was to be simple easily understood and relevant to the person carrying out the input.

Utilising a reductionist approach and adhering to the above criteria the following data structure shown in Fig. 4. was developed. The structure is hierarchical in nature commencing at the assembly level, each assembly being attributed to a specific work area and holding part number and general description data fields. Assemblies are then sub divided into operational elements. Each element being an identifiable step or operation in the assembly process and being carried out at a known workstation. Operation data contains the description of the operation, and the time required to complete that operation. In this way, the operations or steps required to complete any assembly are gathered in their logical order through the use of assembly and operation number fields. Enabling the sub structure formed by the operational elements of the assembly to be clarified and made available to the IT system and its users. In a third level of simplification all identified faults and problems that can occur at each operation are then ascertained and allocated to their respective operations.

The structure was developed during a series of meetings of the COPQ team. The outline emerging from the experiences of the team and from observation of the actual processes and operations involved. Discussions with team leaders and other assembly staff taking place to clarify points not obvious from observation, or which caused disagreement or doubt within the COPQ team. A graphical representation of this structure is shown in Fig. 4.

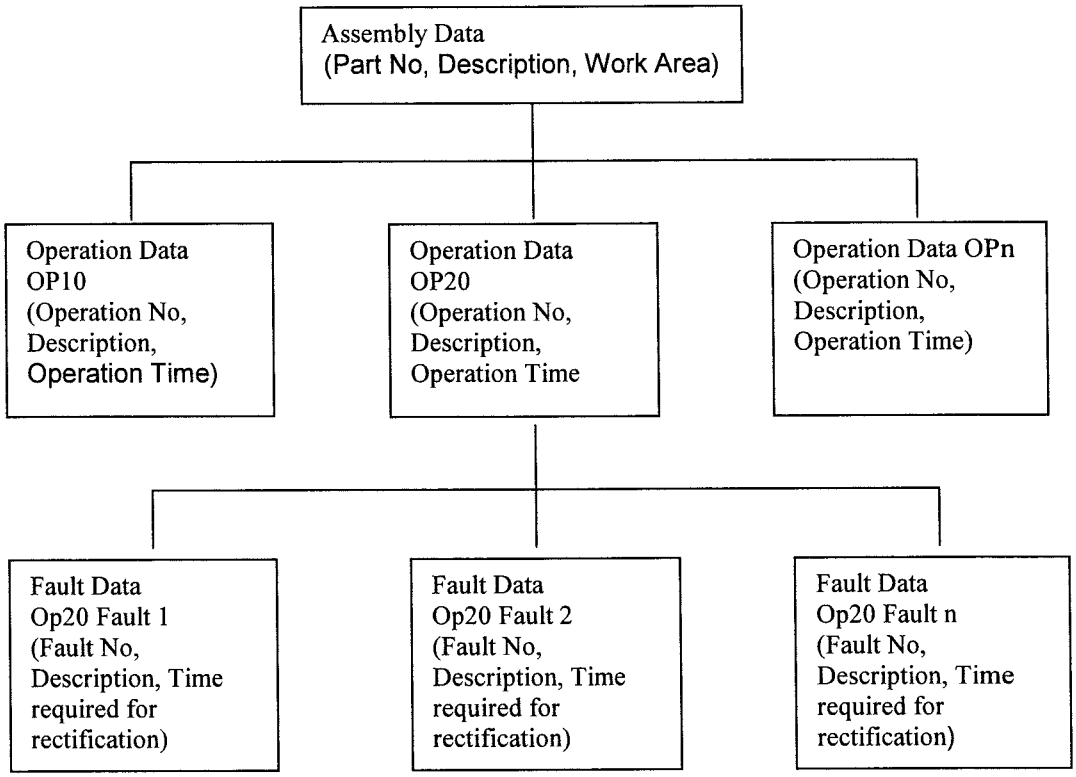

Fig. 4. The COPQ data structure

Each assembly is divided into operational elements. Each element has possible faults identified with both operation and fault rectification time being established.

The reasoning behind the structure is that it should identify the variability within the assembly process. In this way, the system itself can be managed to allow it to deal with the variability encountered. Thus, obeying Ashby's Law of requisite variety, which tells us that within any system, the management or regulatory function must have sufficient variety to respond to the variety produced by the operation of that system. The structure, therefore, maps the variety that can be encountered within the assembly process, thereby, allowing this variety to be tracked and knowledge based responses made. A second reason for choosing this structure is that all staff are able to recognise and associate themselves with the embedded logic of the structure, since it holds a one to one representation of actual situations and events encountered in the assembly process. The structure also lends itself to a series of one to many relationships thus, allowing direct translation to tables fields and prime to foreign keys within a relational database. Another most important reason for selecting this particular structure was the ease of data collection. As each assembly operation is defined and is carried out at a given work station data collection sheets for each operation can be formulated. Therefore, the operators carrying out each operation can collect data at source. Such source data includes the number of operations carried out on a daily basis and the frequency of any fault occurrences. Data collection therefore actively involves the people carrying out the operation, encouraging discussion and consideration of the process and faults encountered. This data can then be entered into the IT system to generate cost and frequency information for each assembly area and for each individual assembly. In this way, data collected in a reductionist format can be supplied as holistic information at an assembly level. The arrived at structure therefore fulfils the needs of the criteria first set out and allows the data contained to be amended as

changes to operational reality take place. These changes occurring as time progresses and improvements are made. Thus, allowing the data within the IT system to always reflect the reality of operational practice at any given point in time. Furthermore, the structure requires the active participation, involvement and co-operation of not only the managerial staff, but of the whole operational staff.

Once the data structure had been developed it was apparent that while the team was able to identify the assembly and majority of the operational data. Only the people actually employed in the respective assembly activities could provide a fully detailed list of faults with the rectification actions and time requirements with respect to fault data. The Nonaka and Takeuchi '*four modes of knowledge conversion* (SECI)' model, was used to convert this tacit knowledge to an explicit form able to be utilised within the data structure (Nonaka, Toyama & Konno 2001). These activities along with the development of data collection documents and methods provided the ability to develop the IT section of the COPQ philosophy.

However, the IT system covers only the data collection and information generation portion of the philosophy. Once the information is available, cross-functional teams from industrial engineering, quality and operational (supervision and staff), must interpret the information producing knowledge, and from that knowledge formulate actions to improve identified quality shortfalls. It is also essential that such information be viewed from a holistic prospective to gain an overall picture of the events occurring within the assembly areas. It is the results obtained from the knowledge actions that bring benefits and cost reduction.

The COPQ philosophy was not the only method considered as an answer to the objective of a 50% reduction in the cost of poor quality. The possibility of applying strict control of operator's processes and methods was also considered, thereby reducing the possibility of variance and reducing complexity to a minimum. However, it was envisaged that such actions would lead to alienation of staff reducing the likelihood of a sustainable successful outcome. In contrast, the method adopted required the active co-operation and involvement of all levels from management to assembly staff. All had a role to play allowing each individual the opportunity to actively participate in the identification of problem areas and long term rectification activities. This approach allowed the focus to be on people not standards. Thus, giving empowerment and an avenue for improvement in quality, interpersonal and group relations allowing people actually involved in the delivery of the quality to drive the improvement process through active participation in obtaining the overall goal.

6 COPQ From Reductionism To Holism and Systems' Thinking

Scientists, engineers and managers have and do use reductionism to deal with complexity (Edmonds, 1996). Within the reductionism - anti-reductionism debate each camp tends to adopt extreme stances (Henson, 1996), advocating their own camp's views. While having only one view may be acceptable within academic debate in reality, a reductionism holism mixture is required within manufacturing. This mixture has been termed by Bruce Edmonds as pragmatic holism (Edmonds 1996). COPQ uses such a mix. While reducing the complexity by specifying the individual aspects of poor quality, it does that by initially clarifying the overall boundaries of the system of quality inquiry. A further systems' thinking approach allows for exploring the interconnections between different aspects.

Systems' thinking requires the larger picture to be viewed taking cognition of the links and interactions between the individual parts within the system (Senge, 1999). Information supplied via the COPQ information system allows the larger assembly wide picture to be viewed. Data collected as individual separate quality events from individual operations represents the reductionist approach. However, to enable pragmatic holism, the reduced data is reconstituted into an assembly level holistic view. This information is then used by improvement teams to initially identify areas for attention. While an assembly level view can still be classed as reductionism at a higher level, from an organisational perspective the identified system boundary (an individually identifiable assembly flow line) it is also holistic. This is the pragmatic holism paradigm of COPQ. The philosophy enables improvement teams made up of all levels within operations to utilise knowledge management to exchange ideas, theories and experiences to develop knowledge and formulate actions designed to improve the quality performance in identified areas. Thus, the approach uses reductionism to hold complexity within manageable levels while at the same time allowing links between operations and assembly flow lines to be included. Consideration of such links, the effects of alteration to one process on others and the system wide implications being part and parcel of knowledge creation and the action determination phase of COPQ. The reductionism, holism, systems' thinking, knowledge management mix adopted, has drawn these strategies and philosophies together to suit the needs required.

7 Conclusion

COPQ started as a cost cutting exercise. However, it evolved into a quality inquiry and quality enhancement tool. This developmental process embraced a mixture of academic theories and principles - reductionism, holism, systems' thinking, and knowledge management. COPQ reinforces the simple truth that often no single academic philosophy or model is suitable for sole use within industrial situations. A philosophical mix suited to the circumstances, culture and particular goal is required. Thus, while broad bands from the mentioned philosophies have and are utilised within COPQ, none suits exactly. The evolved COPQ philosophy is a mix tailored to the culture and aims of Draeger.
COPQ recognises quality standards and the need for compliance while still allowing individuals and groups the flexibility to react to non-envisaged situations, adding to or amending internal standards if required, thus, strengthening the improvement and adaptive culture and forming a feedback loop in which culture encourages improvement and improvement strengthens culture.

Introducing COPQ in practice resulted in reduction of the costs associated with poor quality from 3.5 % to less than 0.5% of overall manufacturing costs. More important, however, was that the introduction of COPQ led to the emergence of a culture that allowed for creation of knowledge, development of ideas, and sharing of information to take place.

While COPQ states the aims and objectives of quality improvement; the methods employed in attaining these objectives are left to the discretion of the development team. The development team, in turn, can recognise the possibility of extending and enriching the original objective. The people that are actually responsible for quality delivery become the driving force behind improvement at Draeger Safety UK Ltd.

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12 APPENDIX B, SAMPLE SYSTEMS WORKSHOP DOCUMENTATION

Appendix B contains sample documentation produced during systems workshops that formed part of the 'second order improvement system' development. The documents were produced as part of the move towards the uses of systems thinking as a method of examining improvement situations.

Appendix B Sample documentation fro systems group workshops

Sample agenda for systems group meeting. This document shows the standard format for meeting amenders used within Draeger Safety UK at the time of the resurch.

NAME OF MEETING	Systems Thinking Workshop						MODERATOR	Allan Nesbit
REASON OF MEETING	Continuation of systems thinking and tools investigation and familiarisation						TIMEKEEPER	
PARTICIPANTS	Systems Thinking Group						MINUTES	
DATE OF MEETING	10/08/05	START	14:30	END	16:00	LOCATION	Main Conference Room	
INVITATION FROM	Jim Brown	DEPARTM.	Ind/Eng	PHONE	397	DATE	27/07/05	

NO.	TOPIC	TYPE*	START	DURATION	EXPECTED RESULT	RESPONSIBLE
1	Open meeting and review of previous meeting. Reports on actions.		14:30	14:45		Jim Brown, Petia Sice,
2	Develop customer satisfaction important contributing factors from previous meeting	E	15:45	15:15	Produce a comprehensive list of important factors	Group
3	Covert Lists into multi view diagrams and why what how tables.	P	15:15	15:45	Convert lists into diagrammatic form enabling further refinement	Teams

	Note Keith Sawyer recommends we select 3 issues or sub categories for our why what how tables and concentrate development of improvements in these areas					
4	Evaluate draft Systems manual for usability. Suggest amendments if required. (Manual to be distributed on 08/08/05 to group for consideration prior to meeting)	D	15:45	16:00	Ensure language and terminology used are understood and explained in none academic (Practitioner) terms. Forward suggestions to Keith Sawyer for his consideration	Group
5	Next meeting time (25/08/05, 13:30 – 16:00)	D	16:00	16:03	Workshop with Keith Sawyer to develop understanding of tools and Systems Manual.	Group

Action list developed in a systems group meeting.

Each meeting generated actions that were attached to the action list. In essence, the action list is a method of ensuring meeting actions are inited and the members of the team are aware of each other's roles and responsibilities.

NAME OF MEETING / TOPIC	Systems Thinking and Tools Workshop Follow up Meeting	DATE	19/07/05
PARTICIPANTS	Jim Brown, Steve Layton, Stan Simpson, Alan Phillipson, Allan Nesbit, Andrew Young Louise Carrs, Lisa Archbold, Linda Johnson Petia Sice		
DISTRIBUTION	Jim Brown, Steve Layton, Stan Simpson, Alan Phillipson, Allan Nesbit, Andrew Young, Mark Thomas, Mike Henderson, Kevin Brown, Martin Winter, Edward Docherty, Louise Carrs, Lisa Archbold, Linda Johnson Angela Temperley, Petia Sice Keith Sawyer		

NO.	ACTION / PROTOCOL	EXPECTED RESULT	RESPONSIBLE	BY	STATUS

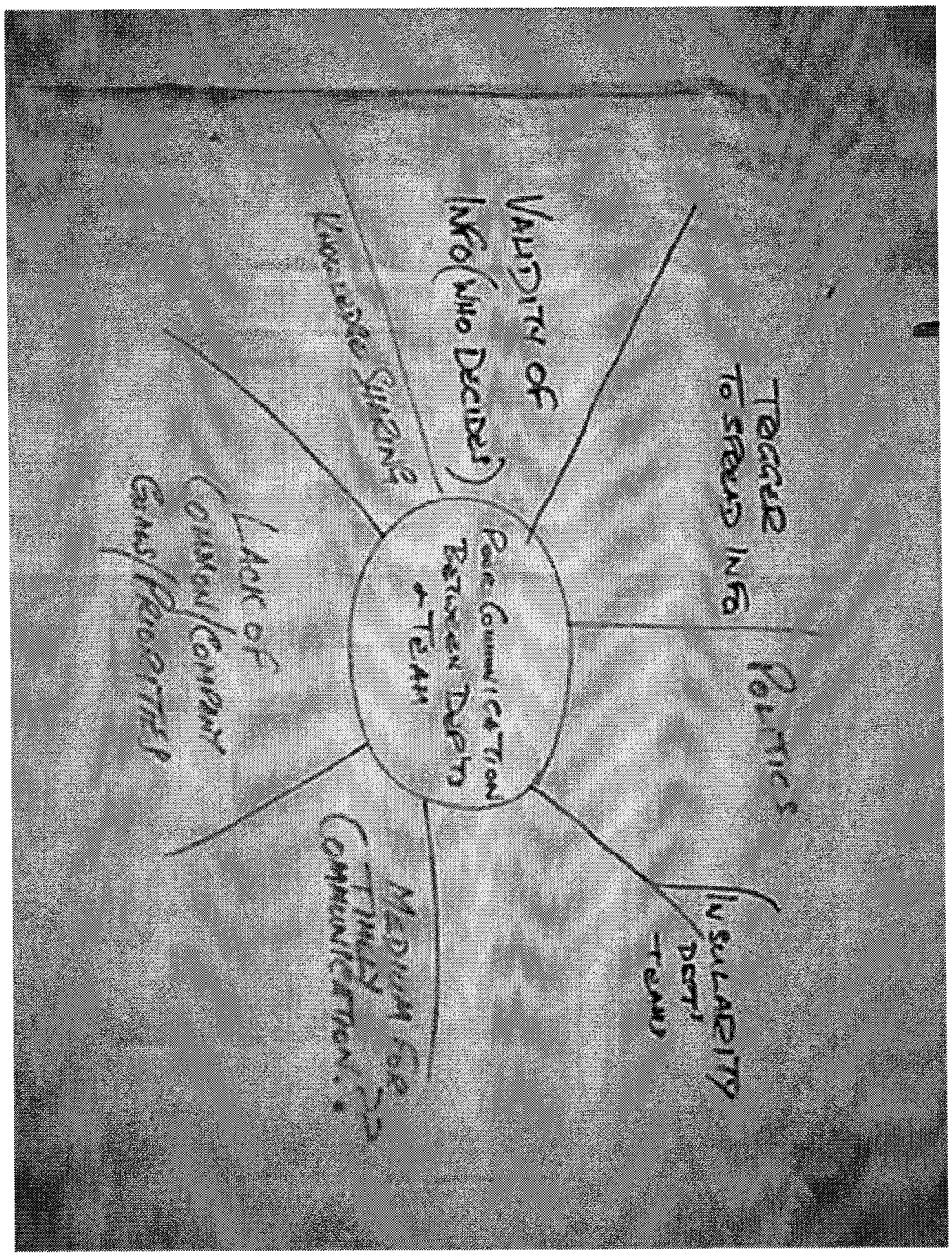
NO.	ACTION / PROTOCOL	EXPECTED RESULT	RESPONSIBLE	BY	STATUS
1	Discussion on the tools there usefulness and if the exploration of their use and application should continue, • The tools are useful and easily understood; • Guidance to the use and application of the tools is required; • The shared opinion within those of the group present was that, the workshop had introduced thinking and tools useful to the company; • Continued evaluation and exploration of systems thinking and tools is of value; • The set of tools used belongs to a systems methodology entitled (OPIUM) '*Organisation Performance Improvement and Understanding Method*' developed by Keith Sawyer of the Open University and the United Kingdom System Society. Keith has given his permission for utilisation of the methodology and tools within Draeger Safety UK.	Decision as to the usefulness of the tools and methods to the organisation	All		[redacted]

NO.	ACTION / PROTOCOL	EXPECTED RESULT	RESPONSIBLE	BY	STATUS
2	Decision on an area to concentrate future investigation the following guidelines being followed: • A subject that has relevance to the group as a whole not just a single department should be chosen; • The subject should be manageable by the group; • Provide an implementable solution to the investigated improvement area. The group decided that as each department and section could identify external of internal customers upstream from themselves the subject of customer satisfaction was suitable.	Concentrate efforts into a manageable organisational improvement that provides demonstrable results within a suitable timeframe (approximately six months)	All		
3	Develop a list of the sub areas thought important to customer satisfaction (see follup190705.doc). • Group to revisit the lists produced and add areas and issues not covered due to lack of time in the meeting.	Begin to define relevant customer satisfaction subjects.	All		
4	Photograph and distribute the two lists of customer satisfaction important issues produced during the meeting to all group members	All group members to have a copy of the lists to enable work on action 3 above	Jim Brown	22/07/05	

NO.	ACTION / PROTOCOL	EXPECTED RESULT	RESPONSIBLE	BY	STATUS
5	Examine existing customer satisfaction documentation and any survey result summaries that might be available. Report findings to the group.	Linda Johnson, Jim Brown		09/08/05	
6					
7	Meeting frequency: To enable speedy progress and maintained interest the group decided that meetings would be held twice a month. The two meeting to have the following durations and purposes • A 1-hour update meeting covering feedback on actions, dialogue on feedback and identification of future actions required. • A 2.5-hour workshop to develop the next stage of the improvement process. • Meeting will follow the doing café approach used in both the workshop and follow up meeting. This approach encourages a free and full exchange of ideas and opinions allowing development of those ideas using dialogue and agreement.	Decide on frequency of group meetings	All		
8	The team decided that a systems language understandable by all individuals within the organisation was required. This language must use plain terms in preference to academic terminology.	Enable a common understood by all to be the systems language used within the company.	All		

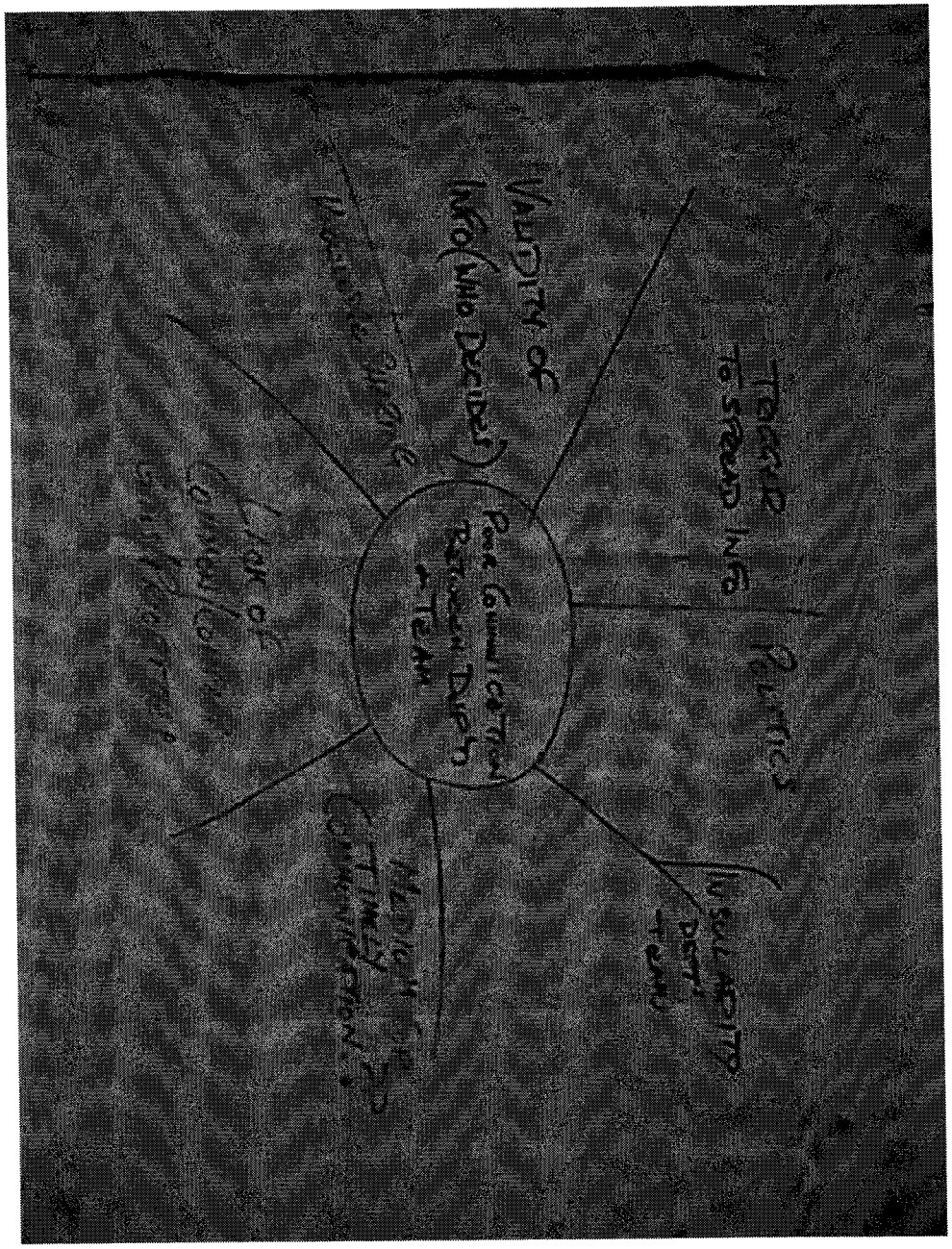
NO.	ACTION / PROTOCOL	EXPECTED RESULT	RESPONSIBLE	BY	STATUS			
9	Being development of a systems thinking tools manual • The manual to give examples and discretions of the uses of the system tools used; • The language used within the manual must be understandable by all levels and all departments within the organisation. Therefore, technical or academic term must only be used when necessary and then fully explained when first used.	Provide a reference and instructional guide to the uses and application of system tools	Jim Brown PetiaSice	Draft by. 09/08/05				
10	Arrange next meeting agenda and venue. Week commencing 09/08/05	System tools and thinking continued familiarisation.	Jim Brown	22/07/05				

The following photographs show team activities during workshops. The chart is hand drawn and follows the OPIUM software Multiview Diagram format.

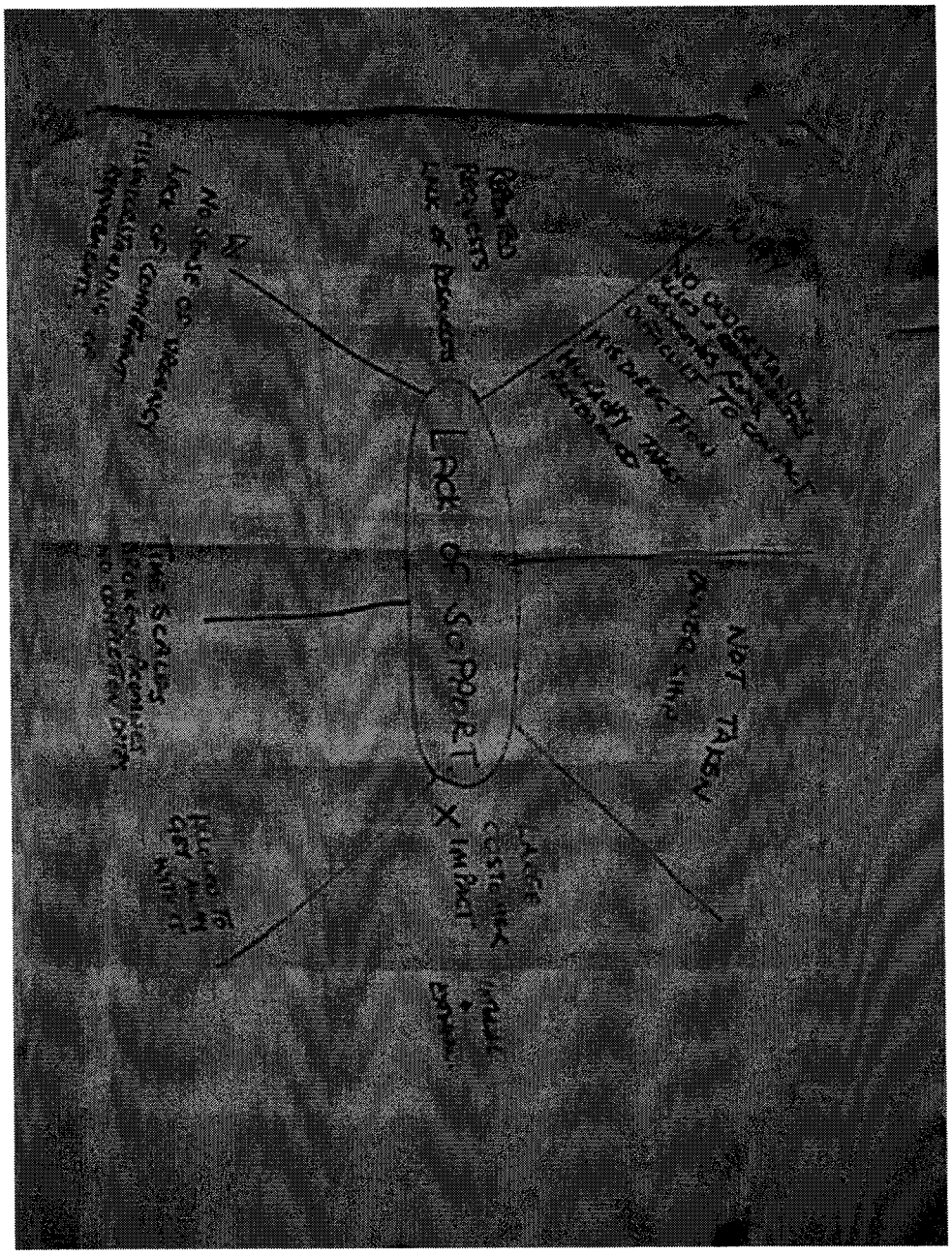


Multiview Diagram

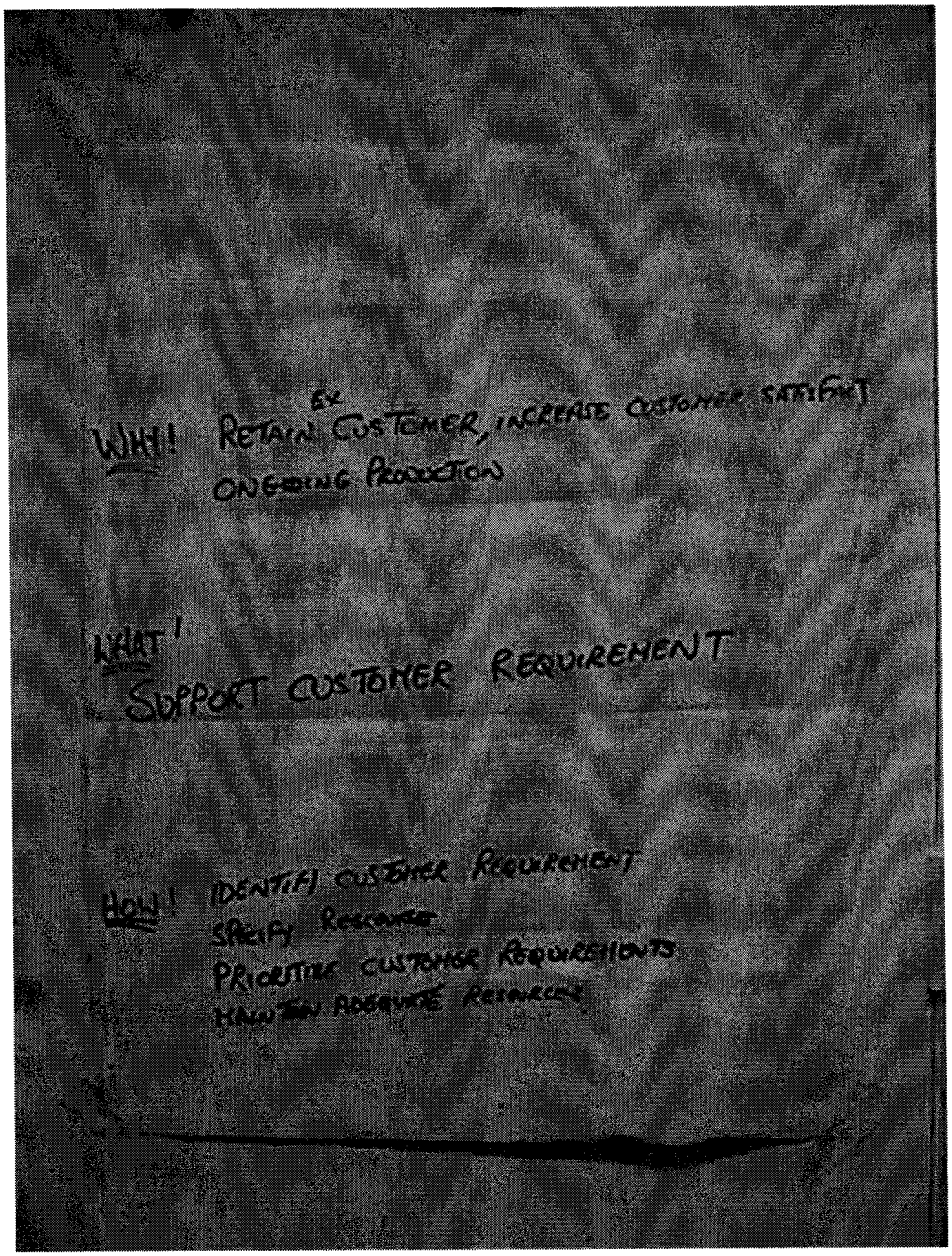
The diagram is formed by placing the subject under review in the centre bubble. Then sectors are drawn to contain linked areas of concern. This then allows the team to see themes develop as the diagram forms.



A second Mulitview Diagram

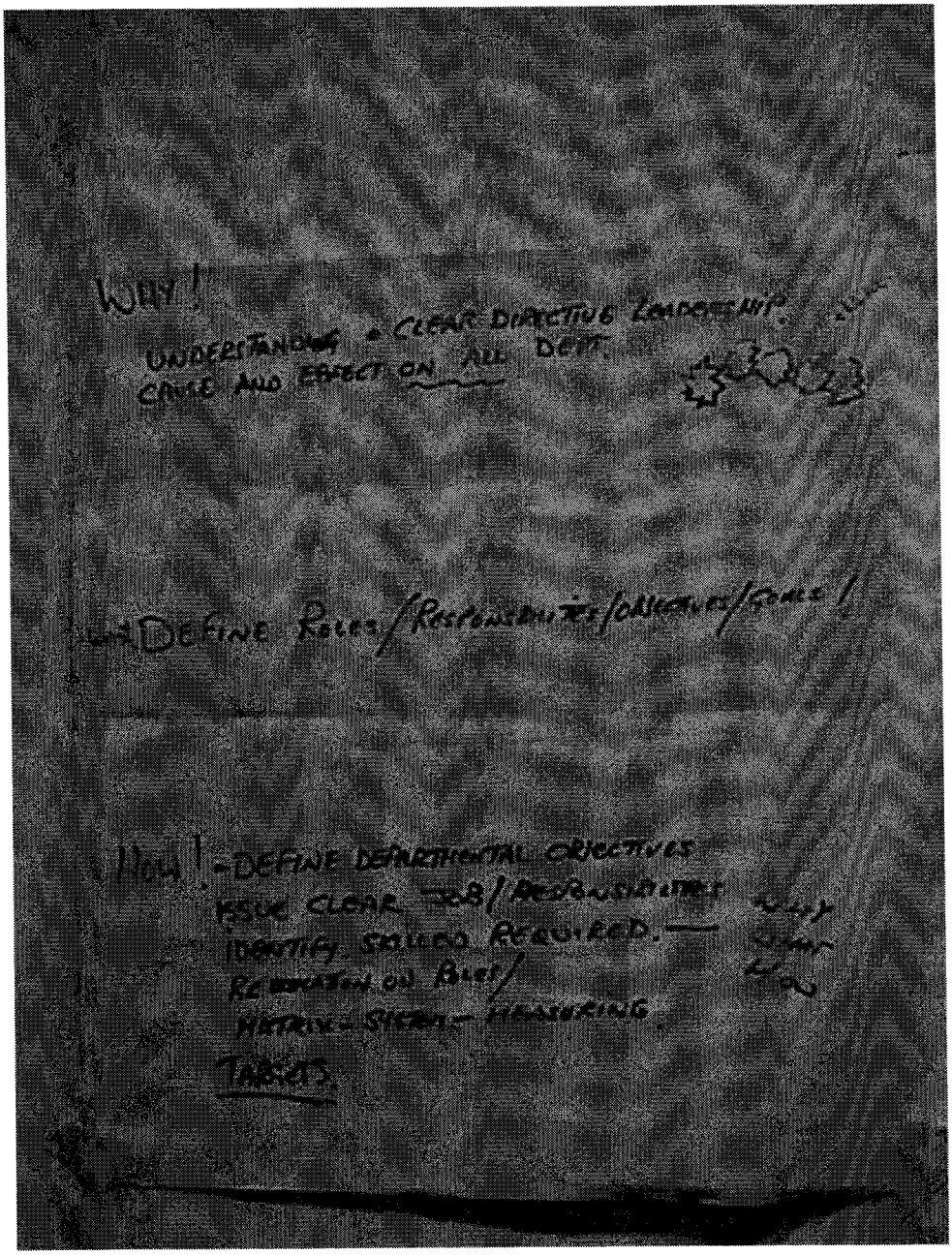


The above Multiview Diagram examines the theme of 'Lack of Support' from various departmental managers etc.

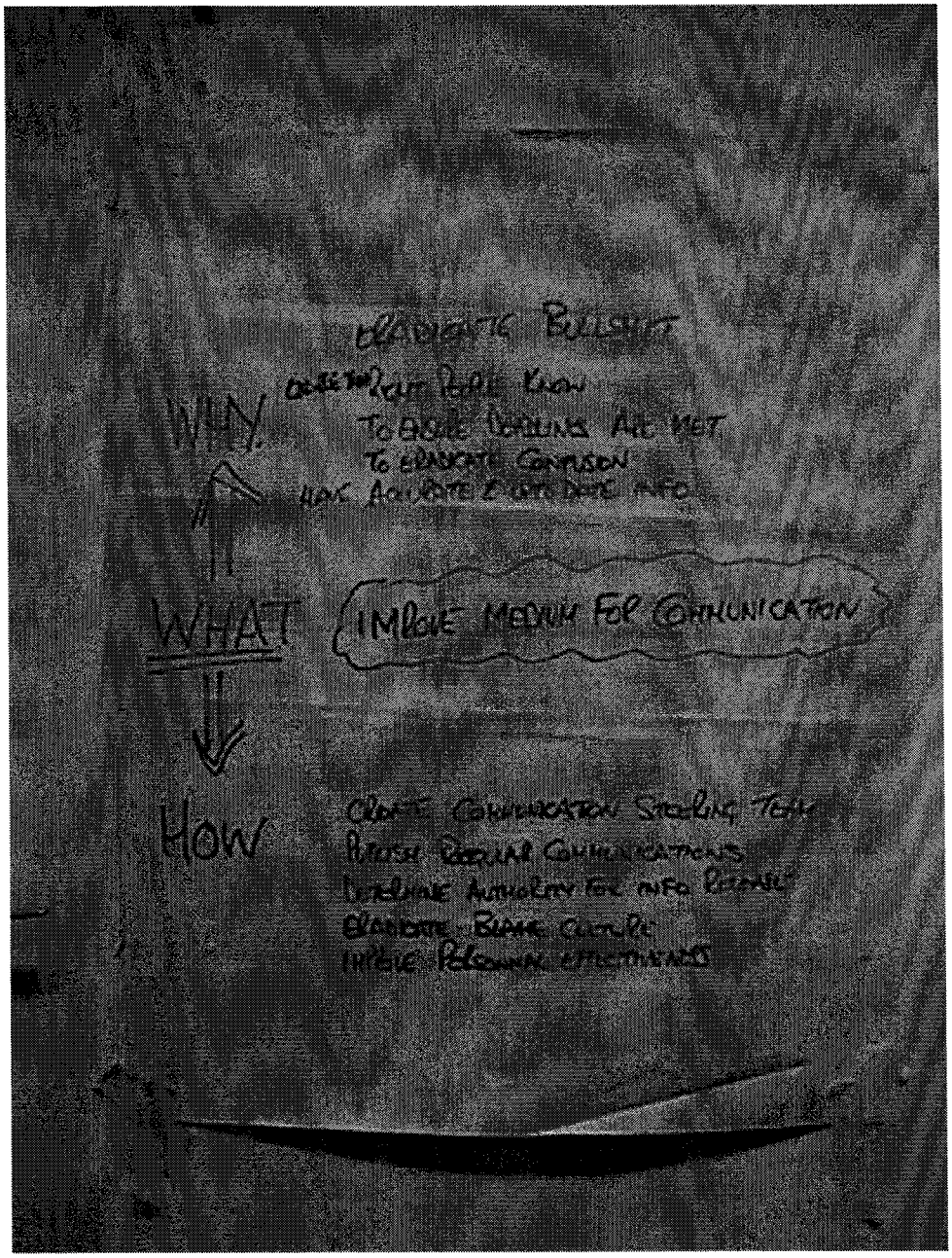


Why, What and How table.

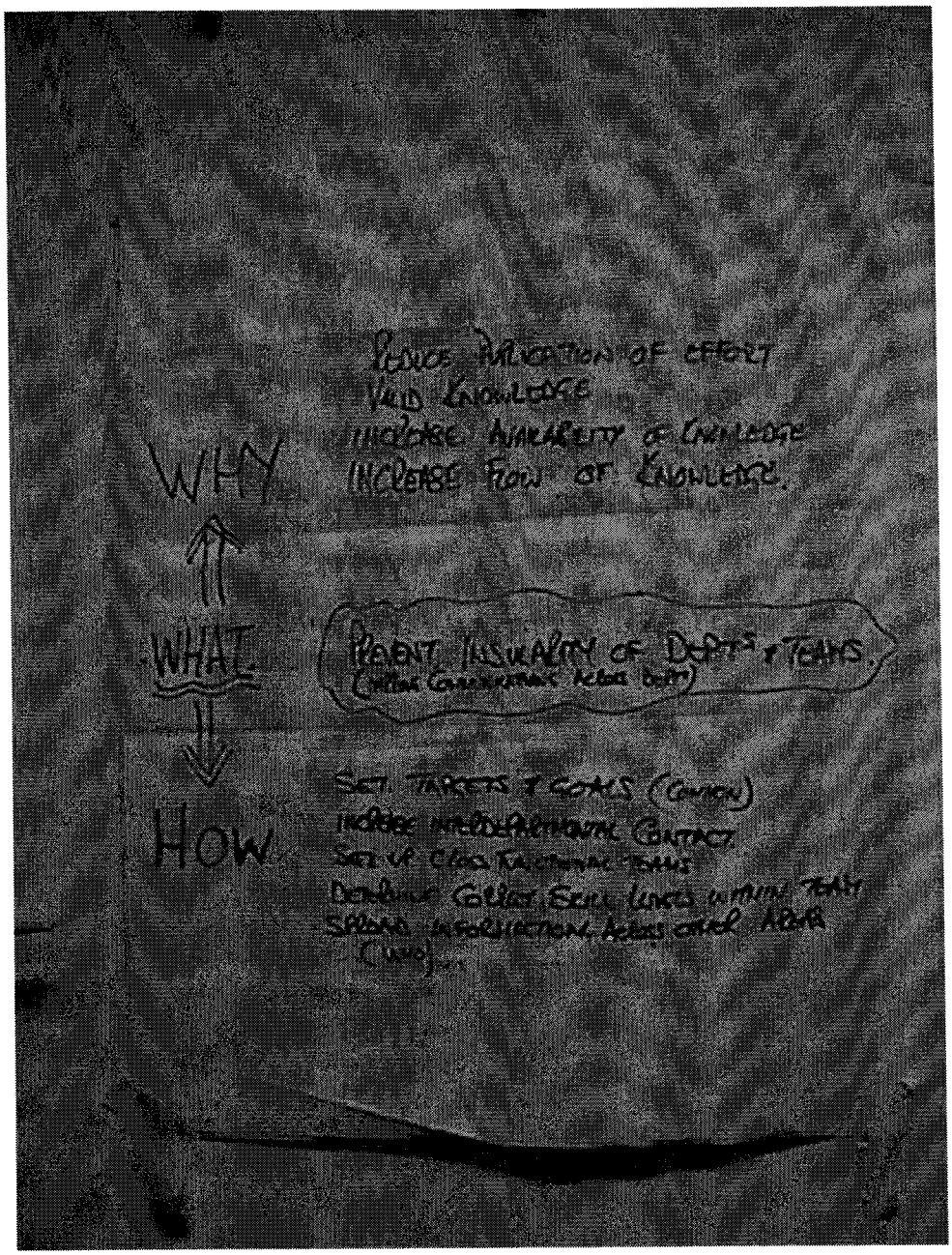
Theses tables are again drawn from the OPIUM software and What is to be done, in this case @Supporting Customer Requirements''. The Why and How say why the what is being performed and the how outlines the method to be used to achieve the what..



2nd Why, What and How table



Why, What and How table Concentrating on Communication Improvement



Why What and How tables eventually are used to build a stratergy tree showing a series of linked Why, What and Hows

The following is a sample of the minutes from a systems group meeting and a persona; reflection from one team member

Systems Group Meeting

24th October 14:30-16:30
Present: Steve Layton, Linda Johnson, Stan Simpson, Allan Nesbit, Jim Brown, Andy Young, Lisa Archebold, Petia Sice

Issues Discussed

Purpose of Contract Review
Authority and Responsibility for Contract Review Co-ordination
Contract Review Meeting
- Participation
- Information provision
- Contract Review Process

DMN for Contract Review

Findings and Recommendations

Purpose of Contract Review

Effective use of resources to ensure that customers get what they want when they want it.

Recommendation (1):
Continuous evaluation of current practices for achieving the above stated purpose is crucial for improvement.

Authority and Responsibility for Contract Review Co-ordination

It is in some occasions not clear who is responsible for the Contract Review Co-ordination. When this occurs, there is no clear ownership of the process.

Recommendation (2):
The responsibility for Contract Review co-ordination lies with the Product manager.
It is possible in some circumstances to delegate the responsibility for Contract Review co-ordination to another person. However, when this is the case, the person taking the responsibility should be formally given the authority for co-ordinating the contract review.

Contract Review Meeting
Participation:

Very often departments are not represented at the meeting which may lead to lack of coordination and delays in ensuring customer satisfaction

Recommendation (3): **A** delegate from each department to be present at the Contract Review meeting(s).

Invite representatives from all departments (as DMN) and included all the available contract and order information.

Information provision

It is not realistic to assume that all information is available at the first Contract Review Meeting.

Problems (delays, mistakes, etc.) occur, as people are not aware of all the information available or required. Information can at times also be inaccurate or insufficient.

The importance of making clear who is responsible for finding and validating various pieces of information should be clear to all.

The Contract Review Process

The Contract Review Process is **not a linear process**. In order to function effectively it must be an iterative process, where the sequence *information provision- decision- action* may require several iterations and therefore several meetings.

There are assumptions that everybody is doing their job correctly, which is not realistic as people make mistakes and have different attitudes idea's and beliefs about the importance etc of contract review.

There is a downfall in the system: there is nothing to point to having actions carried out by anyone; there is no paperwork that keeps track of people completing actions discussed and agreed in the meeting. This is a *quality issue* as action lists are not used at all contract review meetings.

Contract Review progress visibility; with complete and accurate information with meetings supported by action lists, will improve effectiveness.

Recommendations (4-5)

Contract review may involve a series of meetings; action lists need to be introduced to clarify responsibility and current state of progress. This required to:

Get rid of the view that the Contract Review is only one meeting.

Produce a series of meeting to review the Contract.

Provide an action list, if actions are required to find information etc following meetings.

Call another review meeting with a predetermined time to review actions. Sign off occurs only when all actions are completed.

Note: In cases where people complete an action some time prior to the meeting(s), it will be useful to inform the contract co-ordinator immediately to speed up the process if possible.

DMN for Contract Review

In general the DMN is adequate. However, minor amendments are needed to address the issues raised above.

Recommendation: amend the DMN to incorporate the recommendations (1-5)

Pre CR

Further Reflection

As for 'Further Reflection', my own view is that the CR should NOT always need 'meetings'! The difficulty is that our people are not always available at the same time and this 'fact of business life' means that even more unnecessary stress is shouldered by the designated 'coordinator'! Often this coordinator role has been delegated to people such as Linda and her colleagues by the Product Manager and really, there is nothing wrong with that process BUT surely, the CR detail MUST be checked and ratified before sign off by the Product Manager?

Failure to do this basic Review by the PM could jeopardise the contract and should not be tolerated as the 'shirking of ownership or responsibility' for the contract between Draeger Safety and the Customer - by transferring ownership to the telesales ladies - MUST NOT be an option!

All the key persons involved - and nominated for actions on the list - should be able to access and update the Action List either on their own PC or via the CR coordinator. It is vital that the colleagues nominated are compelled to complete their activities & do these tasks in a timely and accurate manner. For me - the difficult bit always - is how to HIGHLIGHT the 'outstanding tasks' and the PERSONS responsible? They must be held accountable and 'spotlighted' until their task is complete & it is understood that the information MUST be accurate & realistic.

If we can eventually build up an electronic database of all Contract Reviews then - in the future - the 'filling in of the blanks' or fine detail will be a much easier task. The choices will probably be taken from 'drop down lists' which have been derived from previous contracts of a similar nature to the one being currently 'reviewed'. When this database has been running and we have some history the whole CR process will become much easier to install and review by our team at Draeger and even the Customer if we desire to use that link?

However in the INTERIM it is essential that we accurately gather our factual data in a timely manner and impose very strict discipline on the KEY participants to ensure that they comply and address these activities - for which they are responsible - so that our customer is always delighted with Draeger Saf

Process Tree and Maps of Contract Review

Actions from Systems Group Meeting 28/11/05
Following the systems group meeting held on 28/11/05, attended by Steve Layton, Stan Simpson, Allan Nesbit, Alan Phillipson, Andy Young, Lisa Archebold, Lind Johnson, Petia Sice, Jim Brown.

The strategy tree and process maps have been developed to aid the group in developing their final recommendations and report/presentation. The intention is to uses the initial desired tree and maps as a focal point to develop and document a joint understanding of the existing and desired contract review process.

Source of information for Initial Strategy Tree and process Maps
The strategy tree and desired process map show below have been developed for our existing DMM (DMM5933-1 Appendix A) combined with the notes supplied by Petia (Appendix B) following the systems group meeting held on 24/10/05. The map of contract review process as it exists presently was produced jointly by Jim Brown and Linda Johnson.

Strategy Tree and Process Map Further Development

The tree and maps will be developed by the systems group at a meeting scheduled for 12/12/05 that depicts the groups' interpretation of the ideal contract review process. Once develop the finalised tree and maps can be used to present the process to customer service managers and other staff for consideration. The final aim being the introduction a single agreed contract review process that replaces the various approaches taken at present. Once agreed the process maps can then be used within process documentation.

A stratergy tree is a linked set of Why, What and How tables as previously shown

Contract Review Strategy Tree

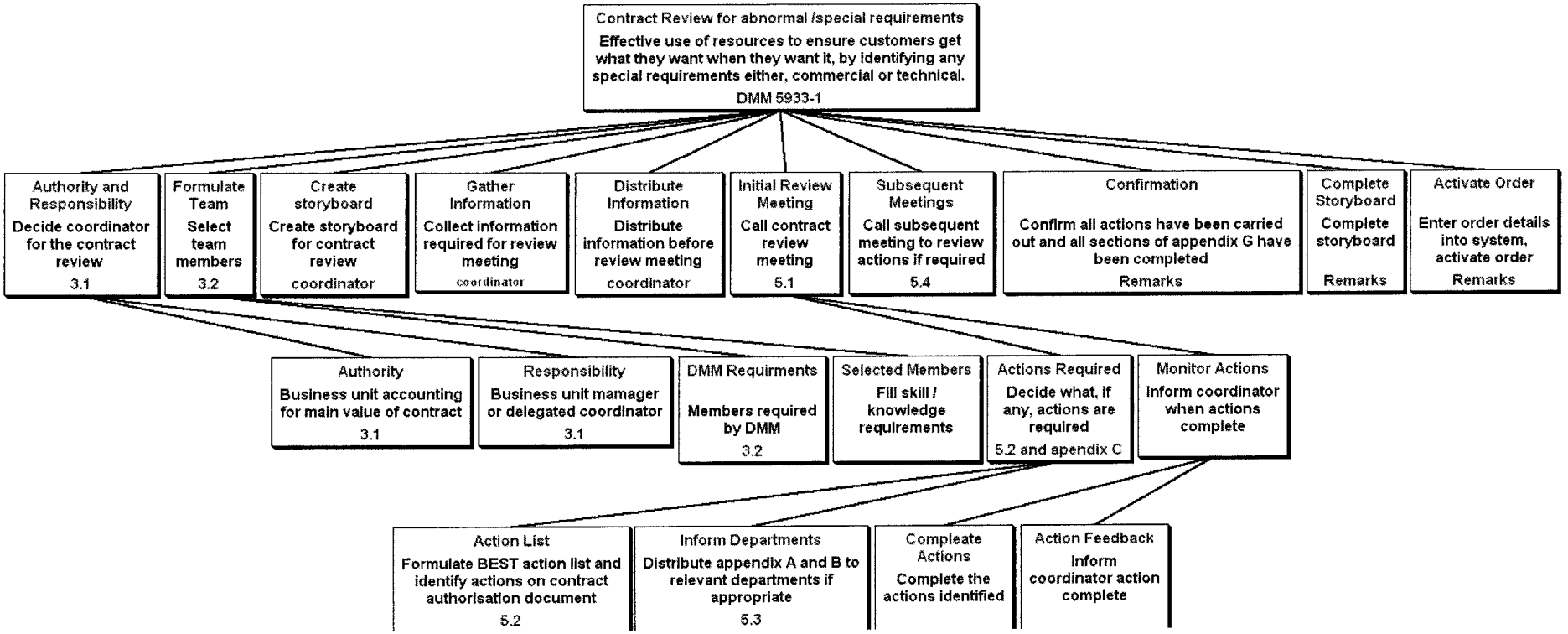


Figure 11 Strategy Tree (Desired Contract Review Process)

Figure 1 above shows the strategy tree as developed from DMM 5933-1 combined with the system notes from the group meeting held on 24/10/05. Figure 1 will form the basis for development of the groups' ideal contract review process.

Map of Desired Contract Review Process

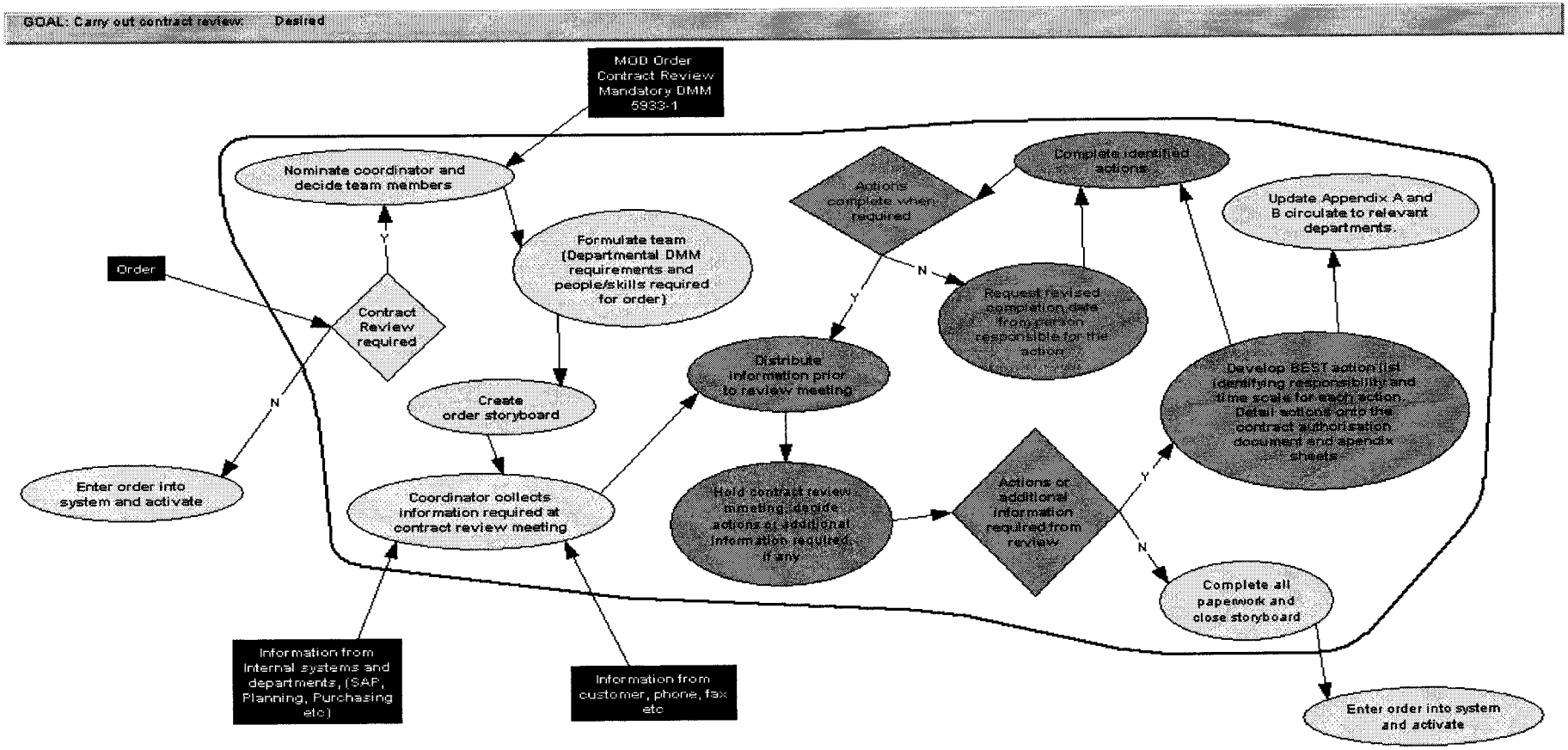
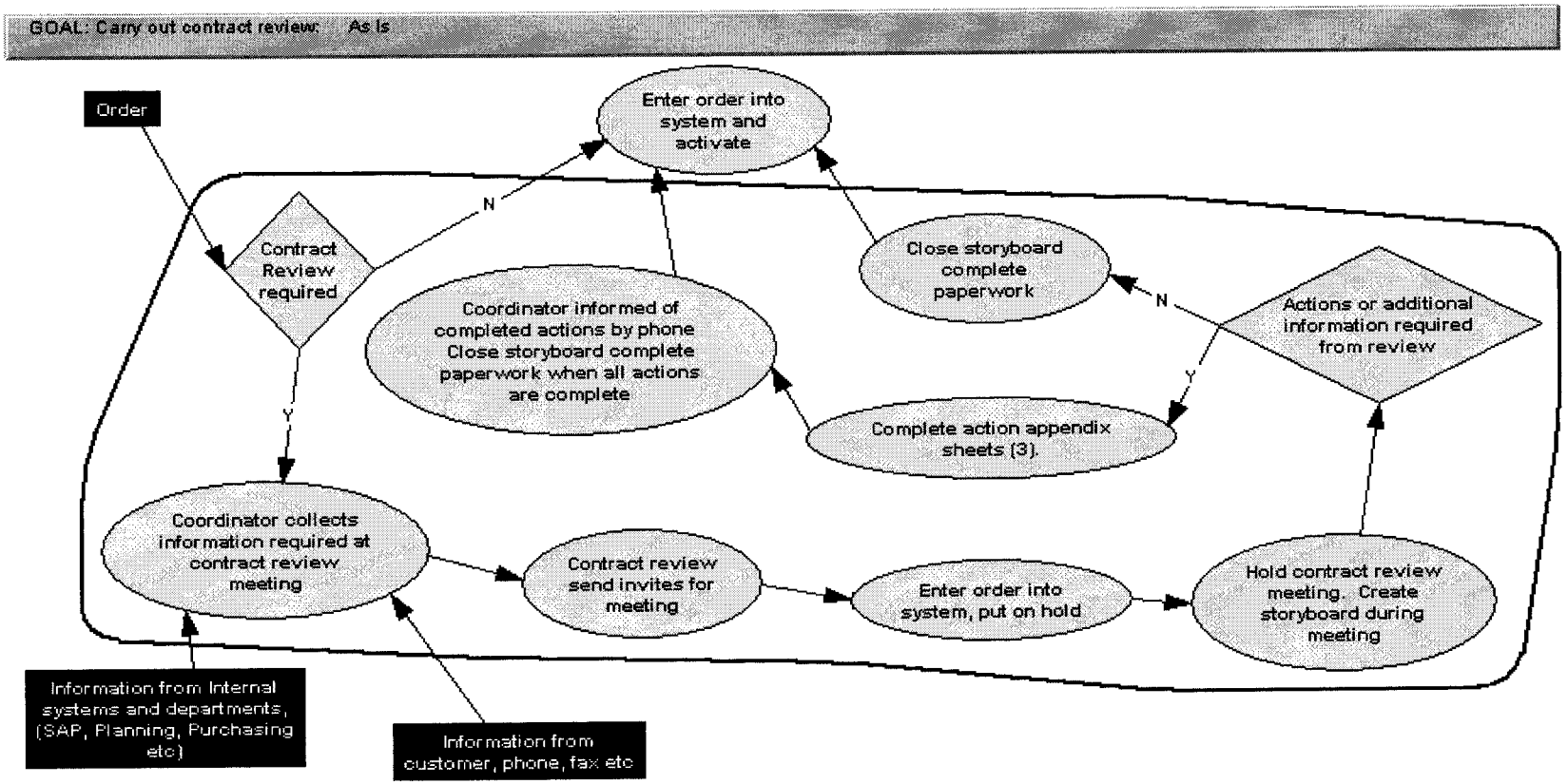


Figure 12: Process Map of Desired Contract Review Process

Within The solid surrounding line denotes the system boundary, ovals show actions and diamonds decisions. The squares hold the extaernal influences that provide inputs to the system. The Process Map is used to show the actual flows if influence between elements of a system.

Map of Existing Contract Review Process



13 APPENDIX C, SAMPLE QUESTIONERS AND INTERVIEWS

Appendix C contains 3 sample questionnaires and three sample interviews. As the questionnaire respondent were promised that the responses would remain confidential the samples have been word proceed. However, the responses have been reproduced accurately.

The three individuals whose interview has been included have given their permission for them to be used. Nevertheless there names have not been used.

The appendix concludes with the themes that emerged from the questionnaires and interviews. The frequency and some quotes are shown.

Sample Questioners

The following three sample questionnaires have been selected at random from those returned. While the originals are hand written theses examples have been word processed to prevent recognition of individuals' handwriting thus, maintaining the anonymity. However, the answers have been copied word for word.

Sample Questionnaire 1

PhD Questionnaire

This is a short 5 Open Question questionnaire. It is intended to collect your thought about your working Life at Draeger. It will be confidential and used as PhD research only. May I thank you for your Help and Support
Jim Brown

Please Indicate **Safety** or GDS

Question 1 What is it that you enjoy in your work, For example The People, Interesting Work, Training Opportunities etc

Answer The only thing I enjoy about my job is the people I work with and getting paid at the end of the month

Question 2 What is it that may cause you dissatisfaction, stress, unhappy experience?

Answer The way some of the bosses stab you in the back to keep themselves out of trouble. This can cause some people a lot of stress

Question 3 What do you think should be explored, looked and improved?
How can these situations be improved in your immediate work situation

Answer Stop putting stress on to the people on the shop floor. I believe the fear factor is still here. Being told if we don't hit order's there are companies out there willing to take our jobs off us

Question 3A Outside of your immediate work situation, (in other activities) or in Draeger in general?

Answer More time to learn other jobs. More promotion opportunities.

Question 4 Are quality standards clear easily understood and available (If not why)

Answer Not enough PC's for people to look up quality standards

Question 5 In your working day how do quality issues affect you (Quality in its widest sense such incorrect components, late delivery, unavailable information etc. In fact anything affecting your ability to do your job).

Answer Has got better over the past 2 months

Sample Questionnaire 2

PhD Questionnaire

This is a short 5 Open Question questionnaire. It is intended to collect your thought about your working Life at Draeger. It will be confidential and used as PhD research only. May I thank you for your Help and Support
Jim Brown

Please Indicate Safety or **GDS**

Question 1 What is it that you enjoy in your work, For example The People, Interesting Work, Training Opportunities etc

Answer Interesting & varied work with occasional mental chalanges

Question 2 What is it that may cause you dissatisfaction, stress, unhappy experience?

Answer Excess workload with a backlog buils up

Question 3 What do you think should be explored, looked and improved? How can these situations be improved in your immediate work situation

Answer Current plans are to split responsibilities utilising two other engineers

Question 3A Outside of your immediate work situation, (in other activities) or in Draeger in general?

Answer Pension plan

Question 4 Are quality standards clear easily understood and available (If not why)

Answer Yes

Question 5 In your working day how do quality issues affect you (Quality in its widest sense such incorrect components, late delivery, unavailable information etc. In fact anything affecting your ability to do your job).

Answer Late delivery of components

Sample Questionnaire 3

PhD Questionnaire

This is a short 5 Open Question questionnaire. It is intended to collect your thought about your working Life at Draeger. It will be confidential and used as PhD research only. May I thank you for your Help and Support
Jim Brown

Please Indicate **Safety** or GDS

Question 1 What is it that you enjoy in your work, For example The People, Interesting Work, Training Opportunities etc

Answer I enjoy the work that I have to do most of the time, as I feel confident that I can do the work well. I also like taking on new tasks that may be a bit more challenging or different, something to think about. I am happy with the people I work with and think that my department are generally friendly and helpful.

Question 2 What is it that may cause you dissatisfaction, stress, unhappy experience?

Answer I do not like it when people ae abrupt or impolite when they need assistance, it makes me less likely to be helpful as I could be, although this does not happen often. I also do not like being unable to complete a job I have been given due to my own inexperience or inability.

Question 3 What do you think should be explored, looked and improved? How can these situations be improved in your immediate work situation

Answer My work situation currently has very few areas to be improved, if there is something I feel I have problems with it can usually be resolved if my manager is told about it. If I think, I need extra training on something it happens

Question 3A Outside of your immediate work situation, (in other activities) or in Draeger in general?

Answer I think that although some measures have been put in place like the briefing and the grapevine, we still aren't a very 'open' company. Lots of things go on in other departments and most people are unaware. I think that with the launch of the intranet this communication system could be improved.

Question 4 Are quality standards clear easily understood and available (If not why)

Answer I believe that the quality standards are clear and easily understood but I don't know if they are easily accessible if you do not have direct access to a PC, as they are all now stored electronically.

Question 5 In your working day how do quality issues affect you (Quality in its widest sense such incorrect components, late delivery, unavailable information etc. In fact anything affecting your ability to do your job).

Answer With the work I do, any problems accessing the Servers, Drives or Lotus Notes on my PC and I can complete very little. All information I need is filed on my computer and if I cannot access it there is not much I can do.

Interview Example 1

J What do you enjoy about your work?

I I think for me Iv always enjoyed the fact that Iv moved across the different departments and boundaries. Iv been involved in lots of areas, its not just something where your sitting at one desk dealing with one thing at a time and you only se a very small number of people. Iv always enjoyed the fact that I do get involved with lots of areas, having said that, that some times causes problems because you do get involved with things where your sometimes thinking, well I shouldn't really be here, I shouldn't really be doing this. Iv got more than enough of me own things to do without getting involved. So I think variety em dealing with people em however good or bad em generally I find people here particularly happy. Particularly ya knaa contented, there always willing to talk to you em and I think to see the changes in the company over the last five years, ten years is a big think for me because I was here when it wasent like that, em but all right there are still certain things when you look back and think it hasn't changed that much, but it has really em it's a totally different place em. The sort of the biggest thing I would like if I could put my wish list in to santyclause for me Christmas present is that, I would love to get an environment where we aren't fire fighting, we aren't chasing our tail, we have problems which if you like are caused by ourselves. That might seem a bit daft but I would like problems that Iv got control off as opposed to some other department or some other situation. So in other words if people went performing or the line wasn't working or technically something was wrong there we could deal with that but I would love to get some product that didn't have a problem that we could concentrate on the real issues of production not fire fighting or chasing our tail on the fact that the product doesn't work.

J that seems to be an opinion held by a lot, the valve block leak keeps coming up?

I I sat one day and looked at every flow line and every product that was on and I didn't have a single product going through this factory that didn't have a problem some where. And that stretched from machine shop with machines breaking down, cylinder manufacture with the pulltrex down or problems with liners, flowline 11 medium pressure creep and other issues sickness, valve block leek on 28, we had incorrect parts on flowline 4 it was just an absolute night mare and that's ya knaa I mean in here there obviously some thing that causes dissatisfaction so Im probably answering both of these in the one. One side what would really make us happy was not to have those what causes the biggest dissatisfaction the biggest distress is just a lack of good quality product going through time after time after time. And he problem is we still have to hit end of month target we are judged on what we achieve monthly in terms of value and you can have as many problems as you like at the end of the day we still have to hit the end results that's what causes the problems basically.

P You say that you have problems with the product design with every product

I Not necessarily product design for every product. Em I think we have got two or three issues there, I believe there is design issues on the two major problems which is flowline 11 in terms of creep and flowline 28 in terms of valve block. But we have other issues in terms of reliability of equipment machinery is getting old we have a single piece of equipment which when it breaks down, the pulltrex is off know it will be off until tomorrow. We are coming to the end of the year, I an already having to ask people to work between Christmas and new year, a situation which I don't like doing because come the 19 of December Vice has gone to Thailand. Jim Varah has gone on holiday Colin Macenze has gone on holiday but us poor people at the pointy end have got to work between Christmas and new year to fulfil what they have promised so that causes problems but its just a straight forward machine problem the quality of parts from outside and things like that so it isnt all design related but there is some major design problems.

P The purchasing, the frequency of the orders, the prediction of when you have orders and things. That causes problems? Do ya knaa in advance?

I Its not two bad I mean to be fair with peter. I mean, since Peter has taken over purchasing the instances of late deliveries has dramatically reduced. The performance of the purchasing is as good as it has ever been. OK there is occasions where he has problems which parts arrive late because he has been let down by his suppliers, it happens. We try and what we have done actually is over the years is we have become very good at being flexible. So we can change around and this what causes people out there a lot of problems because they see again another change in the schedule. But we do manage it we look two or three days ahead and say OK we have got the parts for this product lets build it. Em so yes peter has problems the same as we have problems It happens. Some times, you get parts in and the supplier sent in poor quality.
Sticking with 2 I mean what may cause dissatisfaction again I think the other big thing for me is the lack of clear direction clear strategy, where are we going as a company where are we going as manufacturing. I know people are saying as a company we are going to do 50 million or 52 million or whatever. I think it needs to be a little bit closer to home for me because what I can't see is where is manufacturing going. Ya knaa are we going to expand manufacturing, are we going to contract manufacturing? By that I mean are we going to ship out product are we going to ship services out? Do I look towards expanding the machine shop? Do I look towards investing in the machine shop? So on and so forth. And I think the problem Iv with all of that is I don't know weather the decisions are being made but the focus seems to change. One minuet we are talking about putting sewing section out then we are not! We want to subcontract all the pressing work than we are not! We want to do this then we are not! There isn't a clear stake in the ground that says right in five years or in three years this is what I want to do, I want to have a machine shop that is manufacturing 90% of our product. All Iv at the moment is, if its cheaper to get it done outside then put it outside but that doesn't take in the fact that if I can spend some money on investment on different machines I would be cheaper inside. But at the moment with what Iv if its cheaper outside it goes outside. But where dose that stop? Is that everything? The more work we put outside the less we are likely to spend on investment inside! So therefore the wheel keeps turning, there is nothing we do here as a company that could not be done outside this is the problem! We could by all our machined parts outside, we could go wherever round the world sewing its not a technically difficult job we already get some sewing outside where dose that go? Assembly OK we could keep assembly but get rid of the rest. For me the what causes me most not so much stress but it just the lack of knowing where we are going. We talk About China yea wev got a company in china that's gona build sets where dose that take us? People keep saying that china is not gona have an effect not gona have an effect. Im not stupid at the end of the day we all know that if it is more cost effective to be done there ya knaa there is bigger companies than us and smaller companies than us that has made that decision so again I think a little bit of uncertainty I think em yea companies doing well 50 million record years but where is it gona go? Where is the product coming from to maintain 50 million?
P Who is involved in discussions or decisions?
I Iv got to say Vince I don't know who, I cannot imagine that it is ultimately Vince's decision whether we ship things out to China or whether we close sections down. I am sure there has to be conversations with Jim and Allan Musgrave and people like that but I just feel as if there is nothing there that people can work towards. If the company decision for example is OK in three years we will close the machine shop then fine I will work towards doing that. If the company decision is we no longer want to do any sewing fine we will work towards doing that. But at the minute its up in the air. I cannot get any decisions out of Vince for investment, certainly the sewing section because its wait and see what happens with Helious or wait and see with this its we are in a bit of a limbo situation at the minute I think. So that's probable for me one of the biggest dissatisfactions
P There are certain areas which probably could be automated is there any investment going in

I Well again its yea there is opportunities for investment em I think that the think that always hampers me with that is that I never have a clear understanding of the quantity and the life. I mean I looked at investing in automating reducer assembly a couple of year ago but there is talk about a new product Helious and they may well change the reducer and have a new reducer. So its not like we have ya knaa a car company or a mobile phone where we say look we are going to have to make 200,000 of these a year so therefore we have to automate we are stuck between the two really we try and go so far with automation but probably can not go far enough. We have a classic at the moment, we are talking about buying a new Pulltrex machine which will be sort of state of the art automation for making the cylinders how do we maintain it? We haven't got the skills in maintenance, electronics wise or whatever so its what do you do where do you go with it. But again I not sure we know where we want to go with it as a company that's the problem

J On to three What should we be looking at. Looking to improve

I I think a little bit of that ties in with what Iv just said a clear vision of where manufacturing is heading and that would branch in to lots of things it would branch into skills, it would branch in to training, it would branch into investment em product design and so on and so forth. I think we have come a long way I mean at one time for that we would have said look at improving communications look at improving lots of things like that. I think we have come such a long way with that, that is no longer top of the list. Ya knaa if anybody know puts in these lack of communication I think they are putting that in because that can not think of any thing else now. I think if there is such a thing as two much communication then we must be just about there. The opportunities that people have to express opinions and concerns like we are doing know is another one that goes on top of it all. Ya knaa, monthly communications meetings, weekly briefs, start of shift meetings, end of shift meetings its way over the top so I think I deliberately try to clear away from issues like that think em ya knaa what should be explored looked at and improved your designs could all be grouped into that investment plans and stuff could be put into that but to rap the hole lot up as a clear vision of where manufacturing is heading so everyone understands the future as much as you can get guarantees for the future.

P Do you have any kind of formal strategic documents like strategy

I Iv spoke to Vince a couple of times ya knaa we need to develop a strategy for manufacturing and to be honest we haven't even got a formal system for deciding on what should be made in house and what should be purchased. Peter and I are going to try and sit down after the new year and try to develop that. At the moment we always say can we make it in house or can we not. If we physically can't, we haven't got the technology we very seldom say if we buy the technology then we can. We always just say no we haven't got the technology put it outside. Em which again comes back to a lack of strategy we certainly wouldn't touch anything with electronics but that's a decision that's been made by Vince and whoever that we wont touch electronics so it makes the decisions relatively easy. But other things that come up like that we look at it and say can we buy it cheaper than in house? Yes then it goes outside. Not can we make some investment in house and therefore safeguard some jobs and ultimately make it cheaper that doesn't really fit in. What's the effect of putting all this out on purchasing, what's the effect of putting it all out on stores and goods in who have to handle more parts there must be a cost there, costs of storing it, costs of raising orders, and so on and so forth. None of that relly comes into those calculations. But no I certainly haven't got or never seen or never been party to trying to devise sort of plan or strategy or whatever.

J Do you think they would make a list of critical components and say these will always be manufactured in house because that are so necessary to our production I.E. the actual reducer body?

Well Ill give you a few little insights here but obviously if this is confidential that's fine. Em the statement was made originally I want all of the pressings sent outside. Because Peter could get a price from a company in Italy who was to make the pressings and

machine them and they were cheaper than what we where. Obviously they where supplementing one with the other. But they where making the pressing and then they where machining it. The decision then was is I will shift all of that work outside but I wont put the reducer body out, it is two critical, two month three month later the conversation was that we would put that outside. So I think to answer your question it comes back to what Iv just said before is the lack of strategy, lack of clear policy any think is possible, any thing is game and we are trying to work around this shifting target all the time. One week we have a conversation is no it stops in ,the next week we have a conversation that says it all goes out. But in reality neither has happened yet. We are only just starting to move some of the things out so when we get to the point where that's the last part it will go! No doubt at all about that.
So talk to him about shifting the pressings out, what are we going to do about the people? Pay then off? Can't pay then off its going to cost two much! What do you want to do you are shifting the work out? And that's what we put up with on a regular basis
P I spoke to somebody in marketing Richard somebody (J, Richard Beckworth) who developed the marketing strategy
I So its Richard Beckwoth's job to develop the marketing strategy? Maybe he can develop a manufacturing one for us.
Outside your immediate situation or in Draeger in general I struggled a little bit with this one because everything seems to be OK ish Your back to improvements your back to ya knaa the things we have already talked about. And I think it touches on quality it touches on fire fighting it touches on strategy. If all of those things where in place if the product was flying through here without any major problems then we could begin to explore other issues better systems, more information ya knaa all the things that you possibly go to other companies and see and think that looks good and then you come back and think how do we do that in the situation we have here? The silly thing is we know that we are very successful, we are very successful in doing what we do but my concern is that at some time in the very near future I am sure that will catch up to us we cannot continue to operate and fight fires and jet by with the skin of our teeth the way we do now it will catch up to us in some point in time and will come with such a clatter it will be unbelievable.
J Some times I wonder its almost black arts)
It is you look at the shop flour know compared to what it was like five years ago ten years ago and its totally different. I mean we are building product in a much more professional manner in a much more efficient manner than what we did and I think that's probably one of the reason we have managed to do what we have done. If we had still been building product the way we used to build it and we had the problems we have know I shudder to think what would happen I really do. So I think we could do lots of things but I think while it's a little bit like six sigma right we are talking about looking at six sigma and yet we are running with processes that's got seven eight nines and ten percent failure rates. Its like putting an elastoplast on when you have chopped somebody's head off, ya knaa they are focusing on the wrong things here lets get rid of the big problems if we where down to one percent failure rate then I could say yes lets go with six sigma but at the minute we are still just scratching around and scratching around. So that was difficult that one.
P you said before that if you improve the communications between the marketing and whatever thought the hole company some thing may develop?
I I think that there is going to be benefit there in terms of people much earlier getting to understand and to know what is happening is valid again from a very selfish point of view we get to situation where earlier in the year we where scratching round for work we had people sitting nearly doing nothing, come the last few weeks of the month we want all of that work so therefore we have to now say to people by the way you sat and did nothing in July we now want you to give up your Christmas holidays to work because somebody couldn't tell us what we wanted to do. And I think that causes doesn't cause animosity but it does cause problems, ya knaa because the sales guys are away on holiday and we are

sitting working, so whether that happens or not they might be working. I don't know but the perception is they cannot tell us what they want but then they want it all at the end of the year em and it I don't know I'm not a marketing guy I'm not a sales guy its obviously very, very difficult to do but we are at the pointy end and we get what's left so I think we have put a lot of things in place to improve the communications between the two departments em I mean our planning department sits with the sales guys on a regular basis blar, blar, blar. I don't think you will ever get away from the fact that come the end of the year when we are chasing money well do whatever needs to be done to hit the money, to hit the target

P Are you aware of this customer complaints project? Does it go through the whole company or just marketing?

I It has it dose go through the whole company in a sense there is people from various areas on the complaints committee team I take it this is the team that stands on the CCPC something. It doesn't probably affect me in a sense that it should do because I get very little feed back from them. What should happen is that if we are getting complaints coming in on a regular basis then that should be fed down stairs to say this is the complaints that we get that we had is there some thing that we are doing wrong is there some thing that we need to improve. We have in the past although it dried up recently because I think there was a bit of a crisis within the team we used to get some information down that said this is how the products are performing em we get involved with customer complaints when they come in through service basically any thing that is into service that we feel is beyond the normal warranty type thing. We will get involved we will retest we will do some rework I mean we have done some for the states last month we had some set that came in because of whistle problems we tested them all we verified that the complaint was valid. We get involved in that respect.

J Quality how does it affect you? Do you think it is appropriate?

I OK quality is quality we are producing product for life saving applications we cannot compromise on quality em at the end of the day any thing that you are spending good money on you want to know that you have get value for money good quality, you do not want it to fall apart. I think the difficulties we some times have is this drive for perfect quality and the drive to hit perfect numbers know I'm not suggesting for one minute that we compromise on the safety of the product because we don't. We can't and we don't. I think there is a perception particularly in areas outside of here who believe that we may be do that. But there is nothing that goes out of here which hasn't been fully validated, some change or other that hasn't been validated by our technical department and quality department as towards saying yea it is OK to go. Em we would never in a month of Sundays where we have reject components or reject parts use those without somebody saying there OK to use or whatever. So I think quality is still the number one issue, still something that I think we have got good quality principles. If you like I think where we some times get mixed up is the shall we say the aesthetics side of it. Ya knaa the little bit where people are looking to say well I don't think that looks very good but has it passed its tests is it accurate is it this is it that so I think we get a little bit hung up on that. I wouldn't complain in general about the quality that we ship out, its as good as any where

J What about our standards. Do you think people understand them? The DMNs

I Difficult, difficult I think the answer to that is do people want to understand them and I think the answer to that is no they don't. What they want to do is they want to come to work and they want to know that what they era doing ids correct em a guy that is testing a pressure reducer doesn't want to know a standard that is applicable to somewhere else in the company. He wants to know that what he is doing in the simplest possible terms is correct. now whether that is a DMN standard whether its training records whether its appraisals whatever em and I think that the way we are now approaching quality standards with the new ISO audits and things is probably the better way anyway. It is less onerous on people to read standards and understand then its now a simple flow chart that says OK do

this do that or do that. I think that would make life a lot easier from them definitely in that respect.

J What about poor quality, how does that affect things?

I The poor quality basically pisses everybody off. They get frustrated we get frustrated, em we could miss targets we could miss shipments we could miss orders because of it. If we have a situation where a particular product is falling its extra work for everybody its overtime that people have to work. If its getting out into the field em its reputation its loss of orders again its more work for everybody when it comes back into the company etc., etc. On top of every thing else the biggest sort of threat to us and the biggest problem that we could have is if we started to ship out a lot of product was poor quality.

P The quality procedures that you have, do they change?

I They are dynamic in a sense that if we wish to do something differently then we can, the only thing is that they have to fall within the scope of ISO9002 or whatever it is now. The format of them will be changing now they are changing now. They are going into a much more. Instead of a compliant audit now it's now process orientated. Its asking what are you doing to improve the situation, what are you doing to make sure things don't happen as opposed to saying it says here you will do this. So they are now leaving it very much up to you in terms of how you want to handle your business, but they are more interested in what the out come is. How dose the process guarantee its giving you quality product.

P Do you think that's good?

I I think there is two ways of looking at it I think if you where to look at some thing and say what am I doing wrong or Iv a problem how can I find if I am doing something wrong with the compliance audit its much easier to find out because is says OK it says here that you will do this, you will do that are you doing it? Well no your not OK bang put that right. The other side of it is saying OK you build a product you will identify a reject or you will do this or you will do that and it is not as detailed it is a little bit more woolly if you like. So I think I am not answering your question. The answer is I don't know witch is the best way. I know from an audit point of view its much more difficult to do an audit the new way, much, much more difficult. Because it just opens up every avenue and every area of the company every time you do an audit. You would have done an audit on an area. You would have gone through the standards applicable to that area and you would have ended at the barriers between that department and another department but know it goes everywhere. You could star an audit off in marketing and end up finding a fault in BA assembly. So I suppose at that side of it good because you have found the problem. But to the auditor who now spends weeks doing it instead of a few hours it's a nightmare. So I don't know I really don't know at the moment whether it's a better way or not. I suppose its given you more control in your own destiny type of thing cause all its now saying is look this is the end result we are not really worried how you get to that end result as long as you get there but you better show us how you get there.

J, I What may affect the quality of your performance.

I Every thing you have got there If you come in feeling a bit down yea it will. If Iv had a row with the wife, personnel circumstances will stress from high targets will. Do you like how your boss treated you? Well no if he shouted at me I would be down Do not like how your college treated you well if you engorge me I will be down. How do I think these may be avoided? I think its unavoidable that peoples personnel circumstances will affect there day to day I think that if you have had a particularly drastic time at home I defy anybody to come into work and not feel down. And Iv seen enough examples of people where you think theirs something not quite right here. But it passes so ya knaa that its some thing that's happened personally Me personally I don't know whether I consciously do that, Iv a particularly happy home life so I don't bring my home life I certainly don't take my work life home so I don't know whether I bring my home life into work. I think there is instances of where you aren't getting the recognition that you think you deserve you aren't

necessarily getting the pat on the back that says yea your doing a good job and that gets you down. I think that's a fact and if Iv a bit of a criticism with Vince that's one of the things he docent tend to do that well and that often. It is much more likely at a group meeting to say I am happy with the way things are going than with you as an individual Don't know whether he thinks you are immediately going to say right I want some more money. That's a thing that I think is a stickler with some people. I think the relationships between departments is good I don't think theirs necessarily two many problems that you get from there. I think that's the sort of thing that's going to affect you in the main. At the moment I'm hassled and stressed out like everybody else is. With this coaching that we are doing. We are busy with a couching course with quadrant and our last session is not until Wednesday of next week but we have to have a work based assignment completely finished we have to have a coaching diary completely finished we have to have a least six hours of coaching practice which is all written up in terms of the way the session was planned the way it was handled and feedback all of that has to be ready fore the 17 of December, Iv already said to them it ant gona be. I mean Iv spent three or four hours on a Sunday at home trying to type stuff up and I will be doing it tonight but it isn't going to get done. So yea that sort of thing undue, I think with that is theirs things that happen to you as an individual which people Haven't really thought the consequences through. We are coming towards the end of the year and we are still bunging in as much training as we can we are still taking people away I was gana say for meetings. Ya knaa what I mean it's the impact that people do not realise and people probably sit and think aaa there just winging get on with it but it is a big impact. I mean we took the entire machine shop and cylinders and sewing away and it was it was the sort off the final week of the month it was three day before the end of the month ya knaa and we where saying why? Cos we cannot get it any time else I just wish that people would just before these things are done just have a little bit of thought that says Iv said it numerous times and its not just quadrant training its like the two Allan's and stuff like that. Lets be sensible of when this training needs to be done. Nobody is saying it shouldn't be done but ya knaa finishing a course on the 17th of December when we finish for the holidays on the 23rd and they want it all in its, it isn't gana happen. Ya Knaa they worry about peoples attendance on courses when it comes towards the end of the month it isn't gana happen. So I think that, that gets you down the fact that you are asking people to do these sorts of things and be sensible about it. Em but yea it affects yi

J, I What is you ideal for quality of working life?

P What about a Gym

I Not to work! I think physically I don't think Therese anything at all that you really need to talk about. I mean yea you mentioned Gyms theirs people that think that's gana improve there working like ya knaa I mean I come here at eight o'clock and I go home at half past five, have half an hour lunch I mean I don't want to stop here another two hours after work because wev got a gym if I wona gan to the gym Ill gan to the gym. So I think physically the environment that we are in I don't think theirs anything at all particularly that you would say would really make a great deal of difference. We have good conditions, gota decent office Iv got every thing I need, a computer on my desk and a board and lights, haven't got any heating mind that would be handy that would be a help. So I don't know Iv been to places and herd tails of companies where you pull in through the gates of the company and they have got lovely gardens with statues and fountains and they all walk around with shorts on ya knaa short sleeved shirts and it like Ha Bro. you fine man what happening totally, totally relaxed one of then in particular is body shop they all walk round with sandals on cups of coffee in there hand. Very successful company would that make is any happier, I think not, I think not. I think for me ideal working like? Be appreciated for what Im doing, be told that Im doing well or not in a nice civilised adult manner, not screamed at not shouted at. If Im doing well tell is, reward is for doing well or not give is the tools to do the job what more would I want.

P More Holidays?
I If I had another five days holiday would it make me do my job any better or any worse? Probably not, would I be any happier? I might with five more days but after five six years Id probably think I should have another few days. Honest I don't know, give is forty days holiday a year would it make is any happier? Im not totally sure This is really difficult because its so personal Im sure if you talk to a lot of people out there they will immediately say more money would make them happy and yea it probably would because there own personal circumstance would be improved by having more money.
P Yea but it might make you more happy if you know you contributed to some good cause as a company?
I I think we are then getting into the scenario of what I would call the goody two shoes people who think that way ya knaa and the real bottom line people who come to work for the money. And if it was a choice between then having another ten or fifteen pound a week in there pay packet or the company contributing to a good cause I know which one would win , and it would be the pay packet.
P Is there a philosophy of working lean and very efficient here?
I Again I think its another one which is I think we work reasonably lean by default rather than by plan we streamlined flow lines for efficiency purposes wev put in kan ban we try to do all of the thinks that you would assume is lean manufacturing I think but I don't think we necessarily run the business that way.
P for example you have temps you train them and then all of a sudden you don't need then and they just go
I I know what you are saying. I don't think it's a lean philosophy in terms of having only the bare minimum number of people, I don't think that's that the case. What it is we try to match the number of people that we have with the volume the capacity that goes through. Every week we have a capacity meeting so we look at the capacity for manufacturing, so what is loaded and what do we have capacity for. Know the difference we have to decide how we make that up. We either take product out the plan, we work overtime or we bring in some people. The thing is we will only bring those people in while the capacity is like that, if that capacity disappears then the people disappear that's clear. Wev made big inroads in I suppose lean thinking. The way that we lay out the assembly cells now, the way that we run product through we don't do it in batches the way we used to do it etc. etc. When I say the company hasn't got a lean philosophy I don't think it has, I think its just certain areas adopt certain principles that help as opposed to the culture of the company being every thing is focused on keeping work in progress down, ya knaa putting stuff through as quick as possible keeping people ya knaa efficiency ya knaa keeping movements to a minimum keeping the stock. I mean wev made great inroads on stock through initiatives with still where wev dropped the value of the stock right down. So all of these things are happening and you could probably bring the all together and say well we have a lean philosophy. But I don't think there is any one person or group of people that have actually sat down and said the company is going to go this way and these are the things we are going to have to do. Its almost wev done all of those and then we wake up and think Woo we are working lean because wev reduced this wev done this, wev done this, wev done this. So I think it's a little bit around the wrong way and I think this comes back to probably the them of every thing we have just talked about is there is no clear philosophy or strategy or whatever as to the way we need to go, ya knaa.
J An emergent philosophy rather than a
I Well coming back to that last one there I mean we can work, we could work lean, we could work any other way you wona work and I think we could get an environment where every body was happy either way I think just because you talk about lean manufacturing or whatever it doesn't necessarily mean that you are gona have any issues with that em but again for me just what I said before. Give is the tools, the environments decent, praise is every now and again en let us see where we are going ya knaa give us

some visibility of what's expected id is and where my place is within the company and I will be happy.

Interview Example 2

J Theme 1 what do you enjoy about work, what makes you happy
I As a production engineer what makes me happy is to find solutions to problems that you might have as an engineer. In terms of Draeger what makes is happy is any developments or solutions I might come up with are actually working. They work they do what I expect then to do and I suppose it makes is happy that I get feedback from the people that I give the equipment to that they find it easier to work and the production numbers go up. Im more happy in my job their more happy in their job, their happy so im happy.
P How long have you worked at Draeger.
I Five years, over five years. J You have spent most of those five years on 28 haven't you?
I I was hired as a production engineer to open up and 28 and it was only about a year and a half ago that I was moved on.
J Yes you moved to cylinders but you are still considered the expert on 28
I Im still considered a sort of expert on that process because I was in before quite a lot of people new anything about it, Iv got a lot of background going back year, but that's similar to everybody, everybody has expertise in various areas thought, we all mix and match so that will cover everybody. Yes Im sort of treated a a resident expert on the new product.
P Do you have regular meetings on when a problem occurs?
I Generally as part of a small department we have discussions, open discussions just generally we don't set up particular meetings but we do discuss things and problems that are coming up so we all tend to know what is going on in our department. As regards other areas of production throughout the facility, things tend not to happen that way we don't find out when there is a problem and we have to go and get involved. But as a department we are not big enough to err we are required to know what going on right thou out the factory. If somebody fails to tern up, sick for instance somebody's got to help where he would normally be. So it is informal the types of meeting we tend to have.
P Are you part of this department?
I Ye
J Part of industrial engineering. Any thing else the main ones are finding solutions and getting feedback
I Its part of the job that a have, it makes you happy it gives you job satisfaction. When things you develop make things better, actually work and you see the result of what you have developed on the shop floor making people's job life easier. In theory that's what we are here for making the production numbers go higher so as an engineer that makes me happy.

J On the flip side of that what makes you unhappy, what causes dissatisfaction, distressed.

What makes me unhappy is when the solutions I develop don't work. And obviously distressed from the stress point of view if we have a situation where we have to gat something out at a certain time then we are developing a technique to do that and it fails to work then that gives you more stress. Basically you are up against a production output and if that fails because of what your doing then that's a very stressful situation and its an unhappy experience.

J So really you feel responsible
I Yes well you are responsible to a certain extent. If something fails because of what you're doing then your responsible.
P It can't be helped
I No but that doesn't mean its not stressful and the thing about life is your only remembered for your failures.
J You're only as good as your last job.
I Everything you do that performs as it should is forgotten. It is the fails that you are remembered for "Remember when he did this or that and it didn't work"
J That a fact of life alright
I That life yes but that doesn't help with the satisfaction but I know that as an engineer and that's the way life treats yi maybe that for theme 6 when we get there.
P In terms of the two lines you have worked on, what particular problems have do you experience there. Not that their problems.
I Most of the problems that develop in the factory are around production and getting the numbers out the door and failure to do that because something goes wrong. Not necessarily in the design of the product but actually putting them together. Like for instance this morning, the compressor blew so somebody is trying to find a method of putting the parts together without using any air. Which is not normal practice, but if it goes on for any length of time, it's going to cause us serious problems because most of our machinery works by compressed air. If we haven't got any then weir stopped.
P Why is everybody saying line 28 has more problems that others or is it just me?
I no your just hearing that, its no worse than any other. In most cases its actually better. What tends to happen is, in problems I don't know whether Draeger is any different from normal. It tends to be it go in cycles and you get nothing happening for a while every thing goes\wonderfully well. Then for no apparent reason everything fails and doesn't work. You cant find the reasons for that wev looked and quality have looked and everything is inspected and we cant find the reason why it suddenly just doesn't work. It just dosent. So everybody put a lot of effort in to trey and bottom the problem, get rid of it and some times it rectifies itself. You are only half way through the investigation, it suddenly goes right again, and everything goes off normal again. So you tend not to finish the investigation because you don't usually find anything that permanent and secondly you're more interested in getting back to what's important on a day to day basis. Occasionally flow line 28 does that it stops. So everybody throws a lot of effort to try and fix the problem and it usually fixes its self.
P So when it dose it usually gets better it actually goes better.
I Yes in normal times it goes very well and it was designed to work very well to try and avoid the problems. The trouble is that the problems that we get keep co ming back. Not as badly as it was before with the previous product. But it does come back and you've just got to live with it. We like to sort it and get rid of threproblems completely but it doesn't work that way. Cylinders is the same. You have problems in cylinder just the same. Iv currently got a problem in cylinders aver the road. It might block production for a while but hopefully wi will get that solved, wi will back up and running. But everybody will be running to catch up.
P Do you have to work over the Christmas period?
I Ow no we all end up down stairs at Christmas.
P You mean all of you
J In the last week of the year
I Everybody is running to catch up and get the stuff out the door we usually find we end up doing simple things.
J Go down and work on the lines nothing two complex

J So if we move onto theme 3 What do you think should be explored, looked at and improved. You have said that we tend to work at problem, sort it out then forget about it. Do you think it would be worthwhile to follow it through?

I Ye maybe sometimes I disagree. Sometimes we work at a problem and it solves its self before wev finished investigation and that tends to lose the stem after that because obviously other things have come along in the mean time and displaced it. So you get to the point where are you going to spend more and more effort to solve a problem that is not a problem anymore or are you going to move on to something else. I wonder sometimes whether that's why these repetitive failures ... That's why because we never actually solve it, we carry on and it goes better and we stop. You can also have the argument that why should we spend this effort looking for a solution to a problem that not there anymore till it comes the next time. In the type of work, that we do there will be no solution to a problem. It just happens and goes away and it happens again and goes away again. Maybe we are at the point now because as part of our job we always try to make an improvement in efficiency. So obviously the best thing to do is to look at the most inefficient thing and fix that. Then move onto the next most inefficient thing and fix that. Eventually when you've done all the easy stuff you're left with these tiny problems that keep on coming back but have no odious have no solution and I think that's where we are now. We are trying to fix things that keep coming and going but have no obvious solution. You could spend a huge amount of time trying to sort those problems and never find it. I think that's part of it, there is no solution that's easily findable. I think that's my attitude to them three some of these situations just cannot be improved. They will carry on coming and going. We will do our best when they arrive to reduce the impact. Sometimes there isn't a solution we can find easily.

P Is COPQ part of the [problem solving process

I As a basic tool it may give you hints as to where the problem may be. But sometimes it just point you in a general direction it doesn't actually say "the reason this particular product is not working at this time is because this part has a you know. This rubber part is the wrong hardness.

P Would it help if you actually record that?

I Well the trouble is your operators would spend so mush time recording the information that they won't be doing useful production. So it has to be couched in certain ways that they don't spend two much time but record the pertinent facts. One of the things about generating data is that it is so difficult to give then choices like a multiple choices and have thousands of choices but they can fill it in very quickly. Other wise they just don't do it very well you get to a point to where people lose interest and don't want to fill it in accurately because it takes so long and they've got things they have to do.

P But when you try and sort the problem is it worth trying to record it so you don't repeat the same problem

I There is no problem recording the information because at some stage if you analyse the information there might be a solution there. The truble is recording all the information the terms of the way they think outside is just a waste of time. We see that ourselves for example we've put on COPQ and asked for information and we get problems where they have entered the wrong things in the wrong place. The reasons they've put down are not the right reasons probably because they weren't given the right choices to make. So the information that you generate is only as good as the people putting it in.

J What about our quality standards, do you think they give us any pressure?

I We are between a rock and a hard place in some aspects of our quality aspects. We know we can see we have problems in quality in some of the aspects. In a lot of cases it is in the hands of our suppliers. If we're a minnow as far as the supplier is concerned we can ask them as many times as we wish to improve the quality. To make things better and rectify the problems we see But if they don't think it is not worthwhile and don't do it then we're stuck and in a lot of cases that's the situation we are in. We know what the problem

is wed like it solved but the supplier wont, cant, will not do it. Because we are a competitor in the case of some cylinder components or we are not big enough we haven't got the clout to make them do it. We darnt take our business else ware because there isn't many other suppliers that do that sort of thing. So we are really stuck, we cant take our business else ware we cant make then improve the quality and we've got no other reality so we just soldier on with what we have. If we don't things will stop completely.

P Who are your suppliers are they very big

J The likes of Luxfer who supply liners are massive

I they are a competitor with us and we're not a very big, you know if you've got a competitor who you are supplying components to the attitude to solving there problems isn't going to be high. There not going to be that bothered because they make cylinders as well. There is a gentleman's agreement that we try and help each other. But eventually there comes a point where they say this is not worth our wile. Everybody else has no problems, why should you carry on. Looking from an engineering point, we make the finish to good compared with other manufactures. May be it's a selling point but if I was a fireman I would not be bothered. If you see the state, they come back in for service it looks like they have been kicked around the flour so why do we put a morrow finish on them we make them. The finish does not affect how that hold air so why do we do it. Having quality like that cost us money.

J If we look at theme 5 what do you think affects your performance and other people's performance. Do you think people are under pressure to hit targets

I It does you notice the trend from people you deal with from day to day. A certain times when the stress is on then they tend to pass that stress it on to you. When there asking for something to be fixed people are standing around watching you work. Saying every five minutes is it fixed yet, is it fixed yet. I don't really think, personally it doesn't really affect me, it doesn't give me stress it just annoys me. You tend to find you can work better if you are left alone to get on with it. I can understand somebody told to go away saying if I an standing here hassling you it might get done quicker. It doesn't really work that way. I know that high stress levels in the production areas can affect moral. Iv herd about moral problems on the shop floor to do with high outputs that's been required. Again as a department that hasn't been a problem because we get along together we talk amongst ourselves help with each others problems that sort of thing. Maybe that would help on the shop floor but a fair percent of the people on the shop floor want to come to work, do their days work and go home. At the end of the month, they want to get their pay. Their not really bothered about quality aspects they just want to put the part together and go home again. On the other hand, certain other people are very interested in quality, they want to be involved in quality things, they want to be involved in meetings and about production and things like that. Quite a lot of them don't, its peoples attitude, some people are interested in that sort of thing some aren't. But I don't think it makes a great deal of difference to me, it doesn't stress me. I was always told by my family that I was more stressed at home, than I was at work.

J This brings us onto 6 this beautiful world where everything is perfect

I So everybody lives in peace and harmony. Over the last few years people have said there is no communication within the factory we have improved that. It seems to ge working to a greater extent certainly. Communication is a thing we need. If nothing else it spreads the stress out.

Yes communication is a good place to start.

J What about the way people treat each other.

I A lot of that is personality some peoples styles are easy going its not the way to be a manager. You should be firm but fair. Lets say for instance some people are two firm and some are over the top. You need to tread a fine line. People are now realising you cant be a dictator in their management style. So things have improved. I would rather work for a management that treats me as a human being as opposed to a robot that sits on a

line putting things together all day. Some senior managers we hardly ever see. We understand they have important jobs and cannot be around all the time.
J Thanks that fine

Interview Example 3

J What do you like about working at Draeger. What makes you go home thinking it's been worthwhile today?
I Something new, most days, a sense of achievement and this last three years Iv had to learn a totally new carrier. A total carrier change in the last three years. It has brought up things and lead me into things that I didn't know were there and I am really enjoying it.
P Was it your initiative that changed the carrier?
I No it wasn't it was Vince Smiths.
P Ye but why would he?
I Well he said I am a people person, that's why he chose Allan and myself. Obviously it a people thing, people skills, and he recons we have the people skills. So we were the natural choise.
P What did you do before?
I I used to manage the machine shop.
P So you know everything about production and everything?
I Ye I used to run the machine shop with Malcolm, Malcolm Irving.
J So on the flip side of that what makes you unhappy, dissatisfied
I The only thing that would make me unhappy at the end of the day is if I couldn't get finished what I needed to get finished. But normally in that situation I take the work home and do the work at home, much to the annoyance of me wife.
J Yes Iv got a wife that gets annoyed as well.
I For instance for the past two weeks Iv worked at home every night and all day Sunday doing that coaching thing.
P Are you doing the course yourself or are you supervising
I I'm doing the course,.
J Is that the only thing that the only thing that gets you unhappy, not getting the work finished?
J Folk not turning up to training sessions when there supposed to?
I Aw well yes if you want to really get me going, I have a major problem with people who enrol on particular training courses or particular staff development programs then we give then the dates that each of the particular sessions take place. We find they don't turn up for various reasons and often the reason are we have to go some were else; Iv had another meeting, Iv got a holiday that day, Iv got to go to Germany for so on and so forth. That tells me that they don't attach enough importance to the training programme that we have booked then on. I get very, very angry about that. I sometimes get angry with people who are cheating, coping.
J Dose it happen very much
I Not a great deal, I came across it on my course. Div'nt mention that mind, get rid of that bit. Em a little bit upset in the company strategy or lack of company strategy
J That's come up once or twice
IP What strategy do you mean. Do you mean production strategy or
I Well manufacturing really I suppose, I think everyone is aware of the changes that are going on between the west and the third world if you like an en we've obviously got a lot of threats. I mean we, we are a very, very successful company here we've been very very successful for the parent group. But having said that its all about making money at the end of the day and would there be a stage when they might say, the people here might

say we can get the stuff cheaper else ware well do it; then all manufacturing could be moved, that's a worry

P Is that a roomer? It could come on several occasions, is there a roomer going around?

I No people have em, people understand that various things are being manufactured outside for us now. Things that we used to make inhouse now get done outside because we can get then cheaper. Other reasons are because em small assemblies within assemblies could be manufactured outside and bought outside and it helps us to balance the lines and that sort of thing. But there again we can get things made outside at twenty five percent of the cost of doing them here. The only thing that stops it at the minute are shipping costs. Shipping costs tend to bring the costs back up to the same. So I think at the moment as far as China is concerned we may be all right. But of course it's a worry it's a worry for everyone, through out all industries service sectors and everything. You've just got to look at the call centres, so it's a worry. Unhappy, anything else makes me unhappy or dissatisfied.

P Who is responsible for the stratergy in Draeger is it Germany mainly or is it

I err well I can't really say Petia because I can only speak for what goes on here, and I would say that the strategy here, If it is our strategy is make or buy. Make or buy which ever is the cheaper. It makes good business senesce obviously but with three hundred and seventy people here it's a worry for them, some of then have got to be worried

J So do you think there is anything we can particularly look at or explore in your immediate working situation, to improve the situation or even outside your immediate your immediate working area?

I What I would really like to happen although Im not sure how to go about it is to get everyone not just in operations but operations especially, but everyone else in the company to understand the importance of training. And to appreciate that if we don't train our people we won't improve, if we don't improve we can not be initiative, we then start loosing our share of the world market. Then eventually people pass us and we go to the wall. Perhaps if we stood still in a few years time Draeger Blyth wouldn't be here. But I think that the main bug bare is people not appreciating the importance of the training. The training department actually.

P But on the other side the other hand there is lot of people that feel better of the initiative of training.

I Yes there is no doubt of that Petia yes. Mm a lot of people have been really appreciative of the training that we've organised fore them. Mm but their team leaders and managers as you will, only see it as a drain on their resources. So even at the end of the day they get better more knowledgeable people out of it. They like that at the end of the day they don't like the hurting part that goes on before that when they have to loose their people. I like people that when they come on a course they have to stay on the course. In that respect I think that's about it Jim.

P Do you get appreciated like if you get your achievement do you get awards for your training from outside.

I Everyone who completes a course on the staff development program gets a certificate. There are two or three of the inhouse programs that Allan and me self deliver, we also award a certificate as well on the attainment of a certain mark; there is a test with them as well. But other things are just a case of education really, getting people to attend certain things, half hour sessions and that, so we don't award certificates for that. Other than that there are no other rewards unless certain areas, certain departments give people a salary increase for passing HNC's, obtaining Degrees that sort of thing. I'm not a hundred percent about that, but it does happen I'm sure.

P But are you recognised out side of Draeger for the good training.

I I think it is starting to become recognised, I don't have enough contact with other companies to say that. But from what Iv'e herd from people coming in here Draeger does

a lot of training we do train people. I hear from some tutors and some NVQ assessors, that tin respect to training. The way we bring up our apprentices, that we insist on them learning all the time rather that being out there making things all the time and give them time off to do log books and things there aren't very many companies around here that do that. If any at all, so in that respect we are regarded as very, very good with respect to training as well.
How does it work with the time, how do you give people time?
The apprentices, the apprentices for instance get half a day a week in here, at least a haqlf a day every week when they do nothing but collage work or NVQ work, that sort of thing. People who are say doing management development training, come in here to do their sessions and some of their managers will give then study time on top of that. Not all ahgain you've got the old thing about production manufacturing because we've got to sell at the end of the day. I can't say to then you can come in here next week for a day and study to catch up on your course they'll have to see their manager for that. Ill give then the facility, they can have this, have that or anywhere else, but I can't give them the time off to do it, its gota come from somewhere else.
J How do you find the quality standards affect people in training, say er do you think people take our quality standards seriously?
I er I think they take the quality standards sufficiently seriously ye. From what Iv seen from other places Iv worked, they did have there quality standards but I have not seen anyone who enforces them as well as we do. I was going to say strictly but I think as well as we do is better. We all, I think we all understand that a set of quality standards are there and a quality manual that we work by and everyone does work by it generally by what Iv seen anyway. I don't see a problem, it doesn't harm anything within the training department. Obviously the DMNs gave got their own sections for training. Witch we do stick by 100%. But there is a problem with one or two of the people I mentioned before who are the ones who don't attach enough importance to training. Out of that comes things like assessments and when it comes to assessments time some team leaders and cell leaders don't attach enough importance to that they won't do it. They get behind, it gets reported in meetings, a few arses get kicked and they start working on them again. Its in the DMNs its one of the process and procedures that we work by but in that respect we don't always adhere to it, unless we keep reminding them, keep pushing. But other than that yes they stick by the procedures.
J So if we think about a beautiful world where everything is working, working in harmony, everything at work at home, everything just comes together nicely.
I Like boring?
J Slightly boring is there anything you think we could do to move towards that land of milk and honey.
I Err Im not sure Id like the land of milk and honey to be quite honest with you. You know where everything is ... everything is perfect, you know you want things to go wrong now and again to keep you on your toes don't you. But emm for me self there are things, things here I would like to happen. I would like to se people attaching importance to things I am doing. I mean generally they do but there are some people who don't. Emm I would like to have more facilities, I would like to have come into this a lot earlier than I did, yinar cause Im getting quite old now. If Id come to this a lot earlier Id have had a lot more time to develop me self in this role this function. Because whatever I do I like to do it as well as I can. To the point of being a little bit over the top, Jim is that right.
J mmmh
I Am I total perfectionist normally , I can't think of the words at the minute. What is the word Im looking for?
J Aaaaww yes pedantic

I Pedantic that's right, some tines I get a bit pedantic, I insist on comers and full stops and capital letters in the right place. Its just the way it should be actually. It was hany when I was working with Jim for comers and full stops I was his diconary wasn a.
J aha
I I would like to sort of develop me self better as a teacher.
P Do you teach a lot?
I In here yer, well nar not a lot really not a lot. Perhaps on average about four hours, four or five hours a week.
P Well that's a lot
J Nearly as much as you
P I have eighteen
I But some weeks you mightn't have any at all they are just courses that we have designed and delivered ourselves. We did have, have three years ago when this area started we had a course in Southampton with the CIPD which helped us in designing and delivering the training. Not sure that we do it well, but results tend to say that the things that we do deliver are excepted well and used well.
P So you can go on courses as well.
I Aaaww yer I can go on any course I want really, Its whether I want to and time. Whatever else for this utopia do. I don't think we should force people to do anything, I think you should set then challenges.
P What do you mean?
I If you get a group of people and bring then into here and say. We've got a problem with the fact that you've got to press that switch to get the electricity to come out of there emm you lot just go away and sort it out. That's not... it's a job, it's not a challenge if you will. If, if on the other hand you, we have a farley serious problem in Draeger and its your job to sort it out Jim. You couldn't possibly sort a serious problem of the nature we are talking about by yourself, you would need help, help from a lot of people. To make it more, to make it a challenge and not force it on people because that's what happens here things are forced on people. Would you agree with that Jim
J Yes its been done in the past when people have been told you are going to to that or you are going to do this.
I I would rather say, We've got this fountain of all knowledge, and weve got a problem. Its your job your the leader whatever it is your going to look in house. What's the sort of skills and knowledge and expertise we need to look at this problem. You would pick out a dozen people perhaps. You wouldn't need a dozen people in your team but you've got to pick out a dozen people. Bring then in here and say Iv got a problem who would like to help. Not Iv got a problem you are going to be in my team you are gana wok on the job says Vince Smith. Not that way, which is what normally, happens. You want it to be a way to bring a bunch of people together, your dozen or so. You might not have any intentions of having at all a dozen people in your team, you might want three ot four or five or six. You can bring them all there and give them the option in a way that it's a challenge for then to come in and help. Im not sure Im expressing my self.
J Yer you are
I Rather than saying your job is to help me solve a problem but say will you help me solve a problem. I want you to help me if you can.
P Do people get recognition if they take a challenge?
I When I think of the operations department there are two levels of recognition. One is via the brief I write you get some recognition in there, not officially recognition although it's an official brief. And the other one is employee of the month. Where they get fifty quid and a clock and a certificate and it's put in the brief. But that's a little bit forces as well because it their award they nominate who they want, but you don't always get people putting in for it or nominating people. So with respect to recognition as far as I can see that's it. I am not sure what you would do about it, not sure what sort of recognition. You

see there is recognition and there is motivation isn't there. To me recognition is motivation, to al lot of other people recognition is money. Of cause I like money I like to be paid like everybody else. It doesn't need a five hundred quid bonus to make me work harder that I do now.

J You do it for the challenge.

I I think if you give anybody a challenge they will work harder anyway.

P What prevents people to commit then selves with there full heart other than not being recognised, what else in your experience.

I emm in some people fear of failure, pear pressure.

P Pear pressure what's that

I Well if you were to get your self into a situation that you were working along side Malcolm emm people may then may be afraid to try anything or try to develop then selves because you've got some one who's continuously knocking you. I mean it just like then kids at school. Some times the kids at school don't want to do things because of pear pressure because you've got a couple of bullies in the playground, you've got bullies at work as well. That tends to hold people up as well. People have limits, people have limits and that's just it. MR is excellent but she has identified her limits and does not want to go any farther with regard to learning. What she's done so far is fantastic but she has said that's it. That's the absolute end I don't want to go any farther.

We had some one in the machine shop who wanted to progress, to get more money . He did some training on the machines and spent a few months on then but said I cana handle this, its two complex, can a come back to where I was and he did. I thought it was really good of him, it took a lot of balls to say look Im not good enough to do this so he's where he is now he's not gona go any where.

J Well we are running out of time so we had batter call it a dy. Thanks for your time it has been very interesting.

Themes emerging

The following themes emerged from the answers received to the questionnaires and interviews.

Mentioned most frequently in the replies from the questioners was processes and systems. These varied from direct references to indirect through late delivery, which are process system failures. Following closely were communication and working with colleges.

Below are the main themes that emerged with a selection of quotes. The themes have been listed by order of mention. Some quotes could be listed in more than one category but are only shown once in the most relevant.

Work Processes and Systems (27)

No Technical support, no stock of spares

If we have system problems we tend to work around them

Machine maintenance systems need improvement.

Failure of systems to deliver parts when required.

Drawing update system needs improving.

Sales is not manufacturing, manufacturing process and procedures should not be forced on them.

There are a lot of systems and processes within the company that need to be looked at and streamlined to provide a more effective structure.

Make components in house for improved control"

Translation problems cause delays.

Communication (26)

We still aren't an open company, lots of things go on in other departments and most people are unaware. I think that with the launch of the intranet this communication system could be improved.
Improve communication between departments both ways.
The biggest daily quality problem is information not coming from the factory floor when specific products are on the line which needs to be measured.
A lack of quality information in particular affects daily working.
Communication between staff and employees should be improved.
Not being kept informed about my own teams, I have to hear from operators not my supervisor.
Flow of information needs to be greater.
Incorrect information on drawings
Communication between departments so information is available and not in one persons head.
Lack of delivery and unavailable information are two of the most common problems which affect me directly.
Poor communication of requirements".

Generally working with colleges (24)

I enjoy helping people to develop their abilities to do their job more efficiently
The people I work with are the most enjoyable".
The people that I work with are quite close knit".
Working with a very dedicated team of people who know what their roles are.
In my workplace, I enjoy the company of my work colleagues.
Work mates who are there for you in good and not so good times"

Interesting and Varied Work (20)

The work is demanding but interesting but the rewards are worth the demands.
I also like tacking on new tasks that may be a bit more challenging or different, something to think about.
My Job has day to day variation that makes it interesting
Interesting and varied work with unusual challenges.
I find the atmosphere rather demanding.
Interesting work, this changes from day to day.
Work is interesting most of the time

Quality Issues in Widest Sence (19)

Quality issues occur daily with late deliveries, wrong deliveries,
Incorrect components, stock discrepancy, late deliveries.
Late deliveries and incorrect components means\we miss schedules.
Not enough PC's for people to look up quality standards, make availability an issue.
I become frustrated with poor quality components as I take it personally, as if I have failed to overcome the problem beforehand.
We experience quality issues on a daily basis.

Team Work (18)

I enjoy working in my team and having a variety of tasks to do.
Expanding skills fully is where teamwork, honesty & trust come into play.
Team building allows cross departmental assistance and changes departmental fortresses.
The people I work with, teamwork very good.
Improvement teams should be set up with the shop floor

High Work Load (15)

More employees to cover work load
Not being able to complete work due to time restraints causes frustration.
"Work load, my team are sometimes overloaded by 6 – 8 hrs, with help we mostly manage.
If we don't the question well why is asked?".
Being expected to have five pairs of hands and people not realising that we only have so many hours in a day.
Having to meet tight deadlines and large workloads is stressful.
Work loads placed on you at short notice".

Training and Learning Opertunities (13)

Training opportunities are good; I think the company acknowledges anyone wanting to better themselves".
I enjoy the training but there is no opportunity to take it further.
Training opportunities are good for young people.
Learning and training opportunities are always there.
I find that the training opportunities are very satisfying.

The General working Environment (11)

It helps to get on with your colleagues as this leads to a happy working environment".
A lack of workspace causes difficulties".

Stress (9)

I have been getting very stressed lately due to staff shortages and work not getting done.
Stop putting stress on to the people on the shop floor. I believe the fear factor is still here, being told if we don't hit orders that there are companies out there willing to take our jobs from us.
"Stress and dissatisfaction is caused in my workplace when a job has been completed and is then modified, this means the job has to be done twice.

Having to Fill in for Others (9)

Work overload due to sickness and staff shortages".
I like my job when I get to do it".
Not being able to do my job as cell leader as I have to work on line as an operator for the last three months".
Having to do other peoples jobs" causes dissatisfaction

Lack of Support / No trust in Managers (9)

Supervisors should listen to advice not override it.
Not being trusted or listened too.
Lack of trust from and in my supervisors.

The way some of the bosses stab you in the back to keep themselves out of trouble. This can cause some people a lot of stress.
Lack of managerial support.

Equality (Departmentally and Personnel) (7)

Staff being given equal work and opportunities
Discrimination against women.
Everyone should be treated the same.
Different departments are not treated equally (sickness, holidays, pay scales)
Some departments are more pressurised than others.
There is unfairness.

Peoples Attitude (7)

I do not like it when people are abrupt or impolite when they need assistance, it makes me less likely to be helpful.
The attitudes of some workmates.
The negative thinking of some people, people do not want to be critisised constantly.
"There are too many people in the company who are only too happy to look or go the other way when you need help".

Job Rotation and clear roles (6)

"Job descriptions are needed, people are only too quick to say "not my job". I think it needs defining to a lot of people if things are to improve".
"Define Job roles, fully understand what is expected".
"Cross training to allow job rotation".

Unhappy Experiences (4)

Having suffered both stress and an unhappy experience this does cause an awful lot of dissatisfaction".
Unhappy experience (rather not say on paper)".
"I have had many unhappy experiences , too numerous to mention".

Leadership from the Top (2)

"One people one voice, a knowledge management philosophy starts at the top".
"Must change from the top down, commitment from the top is critical".